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ABSTRACT

This curriculum guide on residential wiring for secondary students is one of six developed for inservice teachers at Marianas High School in Saipan. The guide provides the rationale, description, goals, and objectives of the program; the program of studies and performance objectives by levels; samples of lesson plans for effective delivery of instruction; and a listing of references. Concepts covered include fundamental concepts of electricity, performing basic experiments and manipulative skills involved in electrical occupations, principles and practices related to or applied to residential wiring, theoretical and technical instructions to further develop judgment and decision-making skills, electrical applications and installations directly related to residential wiring, and job-entry skills. Appended materials include job descriptions and tasks, sample lesson plans, sample attendance and progress charts, handouts, safety posters, and instructional resources. (CT)

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CURRICULUM GUIDE

Electricity: Residential Wiring
Secondary Schools

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FOREWORD

This document, Curriculum Guide for Electricity (Residential Wiring) is one of several guides developed during the 1980 Summer Session held for in-service teachers at Marianas High School in Saipan. The in-service workshop was made possible through a federal project titled, Vocational Education Personnel Development in the Pacific Basin, under Section 135 of Title II of the Education Amendment Act of 1976 (P. L. 94-482).

Experienced teachers and administrators representing the secondary schools of the Commonwealth of the Northern Mariana Islands and the Trust Territory of the Pacific Islands developed the guide to establish curriulum standards for vocational education in their respective school systems. It is hoped that this guide will help teachers and administrators improve instruction as well as establish a base for future curriculum development efforts.

The guide provides the rationale, description, goals and objectives of the program; the program of studies and performance objectives by levels; samples of lesson plans for effective delivery of instruction; and a listing of references, supplies, and equipment.

Constructive comments and recommendations will be appreciated. These should be forwarded to either the Department of Education, Commonwealth of the Northern Mariana Islands or Bureau of Education, Trust Territory of the Pacific Islands, Directors of Vocational Education.

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This curriculum guide for Electricity is the result of the cooperative efforts of many people in the Commonwealth of the Northern Mariana Islands, Trust Territory of the Pacific Islands, University of Hawaii College of Education, and the State of Hawaii. Experienced teachers from the Commonwealth of the Northern Marianas and University of Hawaii personnel have contributed toward the development of this guide. However, this guide is for both the Commonwealth of the Northern Mariana Islands and the Trust Territory of the Pacific Islands. The following persons are acknowledged as participants, consultants, evaluators, and support staff for the development of this guide.

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INTRODUCTION

Rationale

The dependence on electrical power by our technological society is so evident that there is very few individuals who can imagine a world without electricity. And yet, the average person is basically illiterate in understanding this vital power source. The result is that many people do not realize the significance and the implications of electrical power in their daily lives as well as in the career opportunities that are available to them.

In the Commonwealth of the Northern Mariana Islands (CNMI) and the Trust Territory of the Pacific Islands (TTPI), electrical power play a vital role in their socioeconomic development plans. The large volume of construction that is currently taking place and also those in the projected plans will require additional electrical power and skilled electrical workers.

In a report prepared by Robert Nathan Associates of Washington, D.C., 1977, states that:

> The large volume of construction that is indicated in the Socioeconomic Plan will strain the capabilities of both the local construction industry and the government. Of these two, the governmental constraint is more likely to be serious and longer in duration. Contractors, skilled workers, and building materials can and probably will be imported rapidly enough to make this a temporary constraint, if government capabilities in decision making and regulation of labor permits could be sharply expanded and made more effective.

It is obvious, even from casual observation and inquiry, that there is a lack of local skilled workers. Most of the skill trade workers are imported alien workers.

The Trust Territory Advisory Council for Vocational Education in its 10th Annual Report stated that with the changing emphasis from government to private employment, it is essential that vocational education be the means whereby students in high schools, which has been the principal area for skill development, acquire saleable skills for direct entry into the labor market. The Council encourages vocational administrators, counselors and teachers to recruit in a positive manner those students who would derive the most benefits from these programs.

The Electricity Program is a sequentially developed program to help students explore the fields of electricity as well as to help interested students who have the desire and capabilities with skills, knowledge and attitudes necessary for entry level employment.

With the every increasing use of electrical applicances and equipment, and the number of new dwellings being built in the Marianas and the Trust Territory, it has become evident that the trend towards importing foreign workers will be on the decline if the educational system can provide the industry with trained and skilled workers. This shift will probably add some strength and stability into our economy, as well as providing our youths with the type of employment opportunities that will satisfy their needs as well as the needs of our islands.

In order to insure that our youths are properly trained and prepared for entry level employment in the electrical wiring industry, we have attempted to develop a common curriculum guide that will meet these needs.

This guide will assist the instructor/teacher to present lessons and shop practices in the most appropriate and efficient manner.

Description

This program is a tri-level secondary school curriculum in Electricity, with emphasis in Residential Wiring.

The first level covers the introductory course where the emphasis are on learning the fundamental concepts of electricty, and performing basic experiments and manipulative skills involved in electrical occupations.

The second level covers the principles and practices which are related to or applied to residential wiring. Theoretical, technical, and related instructions are stressed to further develop judgment and decision making skills.

The third and final level, covers electrical applications and installations which are directly related to residential wiring. Job entry skills are stressed during this final course.

Goal

The goals of the program are to provide training through classroom and shop experiences to develop manipulative skills, safety practices, acceptable work habits, and attitudes for the purpose of gainful and

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meaningful employment. The program has identified and sequenced a course of study that would be common to a wide range of occupations in the electrical trades cluster.

Objectives

The objectives of this program are as follows:

1. Develop skills and ability for occupational competency.

2. Develop attitudes required for entry level employment and advancement.

3. Develop knowledge and habits to perform tasks safely and efficiently.

4. Develop social traits that would be acceptable in functioning in our society.

5. Assist students in mastering basic literacy skills required to meet job specifications.

6. Provide the industry, community, and nation with a trained work force which will attract and promote economic and industrial development.

Objectives are prescribed so both student and teacher can assess the knowledge, skills, and attitudes gained from this course. By prescribing objectives, both different student characteristics and special needs students can be met using this same guide.

This guide should provide a more effective teaching plan and an accountability system would also be implemented. The basic plan is to train students to acquire saleable/marketable skills to satisfy their needs as well as the needs of the industry, community, and nation.

It should be noted that the success of this program is dependent on the quality of the general education and related courses.

PROGRAM OF STUDIES

COURSE OUTLINE LEVEL I

LEVEL I

A. COURSE TITLE: INTRODUCTION TO ELECTRICITY

B. COURSE DESCRIPTION

This is a one year course that will enable the student to learn about electrical theories, such as voltage, current, and resistance and their relationsip to each other. The course covers safety practices, applications of electricity in our daily lives, and the use and care of test instruments.

Practical applications include the use of handtools, test instruments, experimenting, designing, constructing and testing electrical devices and circuits.

C. GOALS

The goals of this course are to introduce the student to the world of electricity and the various opportunities of a career in this broad field. Also to develop skills, knowledge and attitudes that will enhance the student to cope in the highly technological society that we live in today.

D. COURSE OBJECTIVES

1. Appraise the opportunities of a trade in residential wiring and its requirements for employment.
2. Demonstrate habits which are conducive to learning.
3. Explain the importance of practicing safe working habits.
4. Specify the tools most commonly used in the electrical wiring industry.
5. Explain the five sources of electricity.
6. Explain and discuss the distribution system from the power plant to the resident.
7. Solve electrical problems using Ohm's Law.
8. Explain the basic principles of magnetism.
9. Explain the use of three different types of diagrams used in electrical wiring.

10. Install wiring using low voltage equipment.

11. Select the proper scale when utilizing test instruments.

12. Identify commonly used electrical symbols.

13. Demonstrate their ability to use ampacity tables in selecting conductors for general wiring.

14. Select and apply different techniques of splicing conductors.

15. Classify and identify electrical wiring devices and materials.

E. COURSE OUTLINE

*1. Career Orientation

a. Job Description
b. Entry level requirement
c. Job ethics
d. Working conditions
e. Job opportunities

*2. Shop Orientation

a. Shop policy
b. Introduction to course content
c. Grading policy
d. Location of books and references
e. Shop layout
f. Location of tools

*3. Safety

a. Safety program
b. First aid
c. Ventilation and lighting
d. Material handling and storage
e. Location of fire extinguisher

*4. Use and Care of Electrical Wiring Tools

a. Screwdriver
b. Phillips screwdriver
c. Knife
d. Diagonal pliers
e. Long nose pliers
f. Side cutting pliers/Lineman's pliers
g. Channel lok pliers

h. Torpedo level
i. Tape rule
j. Folding rule
k. Chisels
l. Hammer
m. Keyhole saw
n. Wire stripper
o. Hack saw
p. Vise grip pliers
q. Tool pouch
r. Fish tape
s. Portable electric drill

5. Sources of Electricity

a. Friction
b. Chemical
c. Magnetism
d. Pressure
e. Light
f. Heat

6. Electrical Distribution

a. Power plant
b. Transmission lines
c. Distribution lines
d. Services

*7. Basic Electricity DC

a. Electron Theory
b. Atomic Theory
c. Batteries
d. Conductivity of materials
e. Ohm's Law
f. Series circuit
g. Parallel circuit
h. Combination circuit
i. Watts/power

8. Magnetism

a. Laws of magnetism
b. Electromagnetism
c. DC generator

*9. Electrical Diagrams

a. Schematic diagram

b. Wiring diagram
c. One line diagram

*10. Low Voltage Circuits

a. Use of low voltage circuits
b. Procedures in wiring signal circuits
c. Operation of signal devices
d. Signal circuit equipment

*11. Use and Care of Test Instruments and Equipment

a. Handling and transporting meters
b. Zeroing meters
c. Scale setting
d. Identifying polarity
e. Measuring voltage
f. Measuring current
g. Measuring resistance
h. Proper storing

*12. Identifying Electrical Symbols

a. Single pole switch
b. Double pole switch
c. Three-way switch
d. Four-way switch
e. Duplex receptacle
f. Special purpose receptacle
g. Split circuit receptacle
h. Clock outlet
i. Floor outlet
j. Lighting outlet
k. Lighting panel
m. Low voltage push button
n. Lampholder
o. Weather proof receptacle
p. Fan outlet
q. Junction box
r. Bell and buzzer
s. Transformer

*13. Electrical Conductors and Insulators

a. Importance of conductors and insulators
b. Conductor resistance
c. Conductor materials
d. Conductor length
e. Sizing
f. Ampacity

g. Use of tables and charts

*14. Electrical Terminations

a. Pigtail splices
b. Tee splices
c. Western Union connection
d. Terminal screw connection
e. Solderless connections

15. Electrical Wiring Devices and Materials

a. Classification
b. Switches
c. Receptacles
d. Lampholders
e. Junction boxes

16. Guest Speakers

a. Government
b. Industry
c. Professionals
d. Other Instructors

17. Field Trips

a. Power plant
b. Housing project under construction
c. Commerical and industrial installation

F. METHOD OF INSTRUCTION

1. Lecture
2. Lecture/Demonstration
3. Audio/Visual Aids
4. Field Trips
5. Guest Speakers

G. METHOD OF EVALUATION

1. Written Examination
2. Oral
3. Attendance
4. Performance/Application
5. Classroom Participation

H. TEXT AND REFERENCES

1.
2.
3.

I. CLASSROOM EQUIPMENT

1. Overhead Projector
2. 16 mm Projector
3. Colored Chalk

*NOTE: Designates subjects which are covered in one semester.

LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 1 CAREER ORIENTATION

Major Objective: Appraise the opportunities of a trade in residential wiring and its requirements for employment.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Job description	Describe what the residential electrician does	Lecture guest speaker/discussion
b. Entry level requirements	Determine the age and health requirements to qualify to be an electrician.	Lecture Guest speaker from industry
c. Job ethics	Discuss the type of ethics that an electrican should be familiar with	Lecture/discussion
d. Working conditions	Determine if the working conditions of an electrician is favorable for their choice of occupation.	Lecture/discussion Student assignment (interview)
e. Job opportunities	Describe the possibilities for advancement in the field of electricity.	Lecture Guest speaker/discussion

LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 2 SHOP ORIENTATION

Major Objective: Demonstrates habits which are conducive to learning.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Shop policy	Discuss various aspects of rules and regulations of the shop and classroom.	Lecture/discussion
b. Introduction of course content	Assess what is to be learned in the program of study.	Lecture/discussion
c. Grading policy	Determine methods used in grading.	Lecture/discussion
d. Location of books and references	Make maximum use of learning resources	Lecture/tour of library
e. Shop layout	Identify areas that are used as aisles, work-stations, construction areas, tools and material storage.	Lecture/tour
f. Location of tools	Identify area designated as tool room and state procedure in acquiring tools for shop use.	Lecture/tour

LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 3 SAFETY

Major Objective: Explain the importance of practicing safe working habits.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)	SUGGESTED LEARNING ACTIVITIES
a. Safety program	Pass an examination on safety with 100% accuracy.	Lecture/demonstration/ display posters. Handout # 12
b. First aid	List the emergency first aid procedure	Lecture/demonstration Handout Guest speaker (fire dept.)
c. Ventilation and lighting	Explain how improper ventilation and lighting can be hazardous to work condition.	Lecture/Demonstration
d. Material handling storage	Develop proper lifting skills and procedures for handling chemicals.	Lecture/demonstration
e. Location of fire extinguishers	Identify the location of the nearest fire extinguisher and state type of fire it can be used on.	Guest speaker (Fire dept.)

LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 4 USE AND CARE OF ELECTRICAL WIRING TOOLS

Major Objective: Specify the tools most commonly used in the electrical industry.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)	SUGGESTED LEARNING ACTIVITIES
a. Screw driver	Demonstrate the proper use and care of screw drivers.	Lecture/demonstration Transparency TM - 1 - 2
b. Phillips screw driver	Demonstrate the proper use and care of phillips screw drivers.	
c. Knife	Demonstrate the proper use and care of knives.	
d. Diagonal pliers	Demonstrate the proper use and care of the diagonal pliers.	
e. Long nose pliers	Demonstrate the proper use and care of the long nose pliers.	
f. Side cutting/lineman's pliers	Demonstrate the proper use and care of the lineman's plier.	

LEVEL I UNIT 4 USE AND CARE OF ELECTRICAL WIRING TOOLS

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
g. Channel lok pliers	Demonstrate the proper use and care of the channel lok pliers.	Lecture/demonstration Transparency TM - 1 - 2
h. Torpedo level	Demonstrate the proper use and care of the torpedo level.	
i. Tape rule	Demonstrate the proper use and care of the tape rule.	
j. Folding rule	Demonstrate the proper use and care of the folding rule.	
k. Chisels	Demonstrate the proper use and care of chisels.	
l. Hammer	Demonstrate the proper use and care of the hammer.	
m. Keyhole saw	Demonstrate the proper use and care of the keyhole saw.	
n. Wire stripper	Demonstrate the proper use and care of the wire stripper.	
o. Hack saw	Demonstrate the proper use and care of the hack saw.	
p. Vise-grip pliers	Demonstrate the proper use and care of the vise-grip pliers.	
q. Tool pouch	Demonstrate the proper use and care of the tool pouch.	

LEVEL I UNIT 4 USE AND CARE OF ELECTRICAL WIRING TOOLS

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
r. Fish tape	Demonstrate the proper use and care of the fish tape.	Lecture/demonstration Transparency TM - 1 - 2
s. Portable electric drill	Demonstrate the proper use and care of portable electric drills.	
	Identify and name each of the tools above.	

LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 5 SOURCES OF ELECTRICITY

Major Objective: Give examples of five sources of electricity and explain how electricity is produced using those sources.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)	SUGGESTED LEARNING ACTIVITIES
a. Friction	Explain how electricity can be produced by friction.	Lecture/discussion perform experiment (static)
b. Chemical	Explain how electricity can be produced by chemicals.	Lecture/discussion perform experiment (battery) Transparency
c. Magnetic	Explain how electricity can be produced by magnetism.	Lecture/discussion perform experiment (coil, magnet, and galvanometer) Transparency
d. Pressure	Explain how electricity can be produced by pressures.	Lecture/discussion (Phonograph crystal cartridge and scope) Transparency
e. Light	Explain or give an example of a form of electricity that is produced by light.	Lecture/discussion perform experiment with photo-cell.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
f. Heat	Explain how electricity is produced by applying heat.	Lecture/demonstration perform experiment with a thermocouple Transparency
g. Electricity	List six benefits derived from electricity.	Lecture/discussion Benefits: Power, Heat, Cooling, communications, Special controls

LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 6 ELECTRICAL DISTRIBUTION

Major Objective: Explain and discuss about the electrical distribution system from the power plant to the resident.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)	SUGGESTED LEARNING ACTIVITIES
a. Power plant	State the purpose and location of the nearest power plant in the area.	Lecture/transparency Lower Base, Tanapag
b. Transmission lines	Identify the transmission line when shown a distribution system.	Lecture/transparency
c. Distribution lines	Identify and differentiate between the distribution lines and transmission lines.	Lecture/transparency Voltage and distance
d. Services	Identify the service conductors on a drawing or an actual installation.	Lecture/transparency Last pole to resident
e. Feeder lines	Distinguish between feeder lines and service lines and state its function.	Lecture/transparency Conductor between service equipment and panelboard FIELD TRIP TO POWER PLANT...

LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 7 BASIC ELECTRICITY DC

Major Objective: Solve electrical problems using ohm's law.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)	SUGGESTED LEARNING ACTIVITIES
a. Electron theory	Name the three particles that make up an atom.	Lecture/diagrams Ref./Text p. 7 Home Appliance Servicing
b. Atomic theory	State the atomic theory	Lecture/diagrams Ref./Text p. 7-9
c. Batteries	Define terms associated with batteries Primary cells, secondary cells, ampere-hour, battery ratings.	Lecture/display Experiment: Science Act. 8 - Ref./Text p. TM - 7 - 1, 7 - 2
d. Conductivity of materials	Classify conductivity of a given set of materials.	Lecture/demonstration Ref./Text. p TM - 8

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
e. Ohm's Law	e. State he relationship between ohms, volts, and amperes. Manipulate symbols to solve problems when two know quantities are given. State the importance of being able to apply ohm's law formulas to electric circuits.	e. Lecture/diagrams, TM2 & 3 Ref: Text, p. 5 Transparency, TM-9, 10 Lecture/diagrams Ref: Text, p. 5 Lecture Ref: Text, p. 5
f. Series Circuit	f. Explain the relationship of ohm's, volts, and amperes in a series circuit. Solving problems associated with series circuits. Draw diagrams of series circuits.	f. Lecture/diagrams Ref: Text, p. 10 Transparency TM 11, 12, 13
g. Parallel Circuit	g. State the characteristics of parallel circuits. Solve problems associated with parallel circuits. Draw Diagrams of parallel circuits.	g. Lecture/diagrams Ref: Text, p. 12 Transparency TM 11, 12, 13 Lab./Shop: Wire lampholders in series and parallel and prove ohm's law. Assignment sheet.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
h. Combination Circuit	h. State the characteristics of combination circuits. Solve problems associated with combination circuits. Draw diagrams of combination circuits.	h. Lecture/diagrams Ref: Text
i. Watts	i. Define the following terms: power, watts. State the relationship between volts, amperes, and watts. Solve problems using the power formula.	i. Lecture Ref: Text, p. 8 Lecture/demonstration

LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 8 MAGNETISM

Major Objective: Explain the basic principles of magnetism

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED ACTIVITIES
a. Laws of magnetism	State the laws of magnetism	Lecture/Demonstration with magnets. Ref./Text p. TM- _____
b. Electromagnetism	State some applications of electro-magnetism and how it can be strengthened	Lecture/Demonstration with coil Ref./Text p.
c. DC Generator	Name the basic components of a dc generator and its function	Lecture/discussion Ref./Text p. TM ____
		EXPERIMENTS: SCIENCE ACT. 1- 4 - 13

LEVEL I INTRODUCTION TO ELECTRICITY
Unit: 9 ELECTRICAL DIAGRAMS

Major Objective: Explain the use of the three different types of diagrams used in electrical wiring.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Schematic Diagram	Read and trace the flow of current on a schematic diagram. Draw a schematic diagram of a light controlled by a switch.	Lecture/demonstration Transparency TM- Ref: Text
b. Wiring diagram	Draw a wiring diagram of a light which is controlled by a switch.	Lecture/demonstration Transparency TM- Ref: Text
c. One-line diagram	State the use of one-line diagram.	Lecture/demonstration

LEVEL I: INTRODUCTION TO ELECTRICITY

Unit: 10 LOW VOLTAGE CIRCUITS

Major Objective: Install wiring using low voltage equipment.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Use of low voltage circuits	State the uses of low voltage circuits in residential wiring and other applications.	Lecture Ref: Text, p. 141-145
b. Procedure in wiring signal circuits	State the procedure in wiring signal circuits	Lecture/chalkboard drawing - stress three-step procedure Transparency TM-
c. Operation of signal devices	Name three diferent types of signal devices used in residential wiring	Lecture, display devices Transparency TM-
d. Signal circuit equipment	List the equipment and supplies needed for wiring a low voltage signal circuit	Lecture/display Ref: Text, p. 141

LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 11 USE AND CARE OF TEST INSTRUMENTS AND EQUIPMENT

Major Objective: Select the type of meter for determining voltage, ampere, resistance, and continuity.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Handling and transporting meters	State the importance of proper handling and transporting of meters.	Lecture/demonstration Ref: Text, p.
b. Zeroing the meter	Describe the reason for zeroing the meter	Lecture/demonstration Student application
c. Scale setting	Demonstrate the use of each scale on a meter.	Lecture/demonstration Student application
d. Identifying polarity	Distinguish between positive terminals and negative terminals either through color code or symbols.	Lecture/demonstration
e. Measuring voltage	Demonstrate the ability to safely and properly measure voltage across a load.	Demonstration/application Volt meter

LEVEL I UNIT 11 USE AND CARE OF TEST INSTRUMENTS AND EQUIPMENT

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
f. Measuring current	Demonstrate the ability to safely and properly measure current on a given load.	Demonstration/application Ammeter, amprobe
g. Measuring resistance	Demonstrate the ability to safely and properly measure resistance of a circuit.	Demonstration/application Ohmmeter
h. Storing	Explain the reasons for storing meters in a prescribed area.	Lecture/discussion Cool and dry area

LEVEL I INTRODUCTION TO ELECTRICITY
Unit: 12 ELECTRICAL SYMBOLS

Major Objective: Identify commonly used electrical symbols

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Single pole switch	Identify a single pole switch on an electrical plan. Draw the symbol for a single pole switch.	Lecture/discussion Handout # 2 Ref: Text, p. 26-33 Transparency TM-17
b. Double pole switch	Identify a double pole switch on an electrical plan. Draw the symbol for a double pole switch.	
c. Three-way switch	Identify a three-way switch on an electrical plan. Draw the symbol for a three-way switch.	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
d. Four-way switch	Identify a four-way switch on an electrical plan Draw the symbol for a four-way switch.	
e. Duplex receptacle	Identify a duplex receptacle on an electrical plan. Draw a symbol for a duplex receptacle.	Lecture/discussion Handout # 2 Ref: Text, p. 26-33 Transparency TM-17
f. Special purpose receptacle	Identify a special purpose receptacle on an electrical plan. Draw the symbol for a special purpose receptacle.	
g. Split circuit receptacle	Identify a split circuit receptacle on an electrical plan. Draw the symbol for a split circuit receptacle.	
h. Clock outlet	Identify a clock outlet on an electrical plan. Draw the symbol for a clock outlet.	
i. Floor outlet	Identify a floor outlet on an electrical Plan. Draw the symbol for a floor outlet.	

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SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
j. Lighting outlet	Identify a lighting outlet on an electrical plan. Draw the symbol for a lighting outlet.	
k. Lighting panel	Identify a lighting panel on an electrical plan. Draw the symbol for a lighting panel.	
l. Low voltage pushbutton	Identify a symbol of a low voltage pushbutton on an electrical plan. Draw the symbol for a low voltage push-button.	
m. Lampholder	Identify a symbol for a lampholder. Draw a symbol for a lampholder.	Lecture/discussion Handout # 2 Ref: Text, p. 26-33 Transparency TM-17
n. Weatherproof receptacle	Identify a weatherproof receptacle on an electrical plan. Draw the symbol for a weatherproof receptacle.	
o. Fan outlet	Identify a fan outlet on an electrical plan. Draw the symbol for a fan outlet.	

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
p. Junction box	Identify a junction box on an electrical plan. Draw the symbol for a junction box.	
q. Bell or buzzer	Identify the symbol for a bell or buzzer on an electrical plan.	
r. Transformer	Identify a symbol for a transformer. Draw the symbol for a transformer.	

LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 13 ELECTRICAL CONDUCTORS AND INSULATORS

Major Objective: Demonstrate their ability to use ampacity tables in selecting conductors for general wiring.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Importance of conductors and insulators	Distinguish conductors from insulators.	Lecture/demonstration Display various conductors and insulators Ref: Text, p. Transparency TM-18
b. Conductor resistance	State the factors that affects resistance of conductors and insulators.	Lecture/demonstration Ref: Tex, p. NEC Chapter 9, p. 587, Art. 310
c. Conductor materials	State the types of materials most commonly used in electrical wiring.	Lecture/discussion Ref: Text, p. Copper, alluminum,
d. Conductor length	Discuss the factors which determine resistance to its length.	Lecture/discussion Experiment with various lengths of conductors. Ref: Text, p. NEC, Chapter 9, Table 8.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
e. Sizing	State the methods used in sizing electrical conductors.	Lecture/discussion Demonstrate with wire gauge Ref: Text, p. NEC, Chapter 9, Table 8
f. Ampacity	Use the ampacity table to determine the size of conductor for a given load.	Lecture/discussion NEC, ART. 310 Ref: Text, P. NEC, Table 310-16, 17, 18, 19
g. Use of tables and charts	Select the proper table or chart to determine conductor size.	Lecture/discussion NEC, Art. 310, 400, Chapter 9 Ref: Text, p.

LEVEL I INTRODUCTION TO ELECTRICITY
Unit: 14 ELECTRICAL TERMINATIONS

Major Objective: Select and apply the different techniques of splicing conductors.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Pigtail splice	Demonstrate the proper method of forming a pigtail splice.	Lecture/demonstration Ref: Text, p. 147-173
b. Tee splice	Demonstrate the proper method of forming a tee splice.	
c. Western union splice	Demonstrate the proper method of forming a western union splice.	
d. Terminal screw connection	Demonstrate the proper method of forming terminal screw connections.	
e. Solderless connections	Demonstrate the proper method of making a solderless connection	
f. Reinsulating splices	Demonstrate the proper method of reinsulating splices.	Student application

LEVEL I INTRODUCTION TO ELECTRICITY
Unit: 15 ELECTRICAL WIRING DEVICES AND MATERIALS

Major Objective: Classify and identify electrical devices and materials.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Classification	State the factors which determine the classification of devices and materials.	Lecture/discussion Use, rating, size Ref: Text, p. 135
b. Switches	List the four types of switches most commonly used in residential wiring.	Lecture/display Ref: Text, p. 111-138
c. Receptacles	State the applications for various types of receptacles.	Lecture/display Ref: Text, p. 35-38 House wiring simplified
d. Lampholders	Distinguish between keyless and pull-chain lampholders.	Lecture/display Ref: Text, P.
e. Junction boxes	Discuss the process of selecting the proper size junction box for a simple lighting circuit.	Lecture/discussion NEC Art. 370 Ref: Text, p. 24-25

COURSE OUTLINE LEVEL II

LEVEL II

A. COURSE TITLE: ELECTRICAL PRINCIPLES AND PRACTICES

B. COURSE DESCRIPTION

This intermediate course covers principles and wiring practices which are utilized in electrical circuits. Safety practices as well as code requirements and wiring techniques are stressed.

Students are taught the procedures in making electrical terminations, selecting overcurrent devices, and wiring various electrical circuits utilizing approved wiring methods and materials.

C. GOALS

The goals of this course are to provide the means by which the student can understand the principles and practices that are essential for pursuing a career in the residential wiring industry. The student will apply skills that can be applied to a wide range of occupations in the electrical field.

D. COURSE OBJECTIVES

Upon completion of this course, the student will be able to:

1. Recommend practices that promote learning
2. Develop habits that prevent accidents
3. Explain the difference between Direct Current and Alternating Current and its applications
4. Utilize the NEC and Standards in wiring practices
5. Explain the procedure for calculating the number of lighting circuits required for a residential dwelling
6. Demonstrate and apply various electrical terminations
7. Utilize the proper electrical symbols when drawing electrical diagrams
8. Select and explain the use of electrical wiring devices and materials
9. Explain the purpose and principles of overcurrent protection
10. Apply wiring methods recognized by the Code
11. Determine the proper size conductor for grounding an electrical system
12. Determine and select the proper materials for a service entrance
13. Analyze basic wiring problems in lighting circuits and correct them.

E. COURSE OUTLINE

1. Shop Orientation

a. Shop policy
b. Introduction to course content
c. Grading policy
d. Location of Books and References
e. Shop layout
f. Location of tools

2. Safety

a. Safety program
b. First aid
c. Ventilation and lighting
d. Material handling and storage
e. Location of fire extinguishers

3. Basic Electrical Theory AC

a. Uses of AC current
b. Cycle
c. Frequency
d. Phase
e. Voltages
f. Transformers
g. Inductance
h. Capacitance

4. Introduction to the NEC and Standards

a. Purpose of the NEC
b. Scope
c. Code arrangement
d. Definitions
e. Fundamental rules
f. Interpretation
g. Enforcement
h. Examination of equipment for safety
i. Wiring planning
j. Revision
k. History of the NEC

5. Electrical Blueprint Reading

a. Introduction to blueprints
b. Material description
c. Scales
d. Types of drawing
e. Calculations

6. Electrical Terminations

   a. Types of splices
   b. Reinsulating splices
   c. Use of soldering iron and solder
   d. Use of crimping tools
   e. Use of terminal clips
   f. Preparing conductors for termination
   g. Use of split-bolt connectors

7. Electrical Diagrams

   a. Use of diagrams
   b. Symbols
   c. Single Pole
   d. Three-way
   e. Four-way
   f. Lighting circuit
   g. Combination of switch and pilot light

8. Electrical Wiring Devices and Materials

   a. Definition
   b. Switches
   c. Receptacles
   d. Lampholders
   e. Junction boxes
   f. Panelboards
   g. Conductors
   h. Cables
   i. Raceways
   j. Cords
   k. Attachment caps
   l. Fasteners

9. Overcurrent Protection

   a. Purpose
   b. Types
   c. Selection
   d. Usage

10. Wiring Methods

   a. Raceways
   b. Cables
   c. Selection and application of wiring method

11. Grounding

    a. Purpose
    b. Types of grounding
    c. Methods of grounding
    d. Bonding
    e. Selecting grounding and bonding conductors
    f. NEC requirements

12. Electrical Service Systems

    a. Types of services
    b. Parts of the service system
    c. Calculating service sizes
    d. Selecting service entrance materials
    e. Installing services
    f. NEC requirements

13. Troubleshooting Procedures

    a. Analyze electrical circuit
    b. Determine malfunction
    c. Restoring problem
    d. Retest

14. Guest Speakers

    a. Government
    b. Industry
    c. Business
    d. Other instructors

15. Field Trips

F. METHOD OF INSTRUCTIONS

1. Lecture
2. Lecture/Demonstration
3. Audio/Visual Aids
4. Guest Speakers
5. Field Trips

G. METHOD OF EVALUATION

1. Written Examination
2. Oral
3. Attendance
4. Performance/Application
5. Classroom Participation

H. TEXT AND REFERENCES

1.
2.
3.

I. CLASSROOM EQUIPMENT

1. Overhead Projector
2. 16 mm Projector
3. Colored chalk

LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 1 SHOP ORIENTATION

Major Objective: Demonstrate habits which are conducive to learning.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Shop policy	Discuss various aspects of rules and regulations of the shop and classroom.	Lecture/discussion
b. Introduction of course content	Assess what is to be learned in the program of study.	Lecture/discussion
c. Grading policy	Determine methods used in grading.	Lecture/discussion
d. Location of books and references	Make maximum use of learning resources.	Lecture/tour of library
e. Shop layout	Identify areas that are used as aisles, work-stations, construction areas, tool and material storage.	Lecture/tour
f. Location of tools	Identify area designated as toolroom and state procedure in acquiring tools for shop use.	Lecture/tour

LEVEL I: ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 2 SAFETY

Major Objective: Explain the importance of practicing safe work habits.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Safety program	Pass an examination on safety with 100% accuracy.	Lecture/demonstration/ display posters. Handout # 12
b. First aid	List the emergency first aid procedure	Lecture/demonstration Handout Guest speaker (fire dept.)
c. Ventilation and lighting	Explain how improper ventilation and lighting can be hazardous to working conditions.	Lecture/demonstration
d. Material handling and storage.	Develop proper lifting skills and procedures for handling chemicals.	Lecture/demonstration
e. Location of fire extinguishers	Identify the location of the nearest fire extinguisher and state type of fire it can be used on.	Guest speaker (Fire dept.)

LEVEL II ELECTRICAL PRINCIPALS AND PRACTICES

Unit: 3 BASIC ELECTRICAL THEORY AC

Major Objective: Explain the difference between Direct Current and Alternating Current and its application.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Uses of AC current	State the reason why AC current is used more frequently than DC current in our daily lives.	Lecture/diagram/discussion Ref./Text. p.
b. Cycle	Define the term "cycle" and state the frequently used ac cycle.	Lecture/transparency/handout (scope) Ref./Text. p.
c. Frequency	Define frequency	Lecture/diagram/handout Ref./Text. p.
d. Phase	Define the term "phase" and state the type most commonly used in electrical wiring.	Lecture/handout
e. Voltage	State the behavior of voltage in AC with comparison to DC electricity.	Lecture/diagram/transparency Ref./Text. p.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
f. Transformers	State the principal operation of a transformer and its application.	Lecture/diagram (stress induction) Ref./Text. p.
g. Inductance	Explain the behavior of inductance in an AC circuit.	Lecture/diagram Ref./Text. p. Stress "current lags voltage"
h. Capacitance	Explain the behavior of a capacitive circuit.	Lecture/diagram Ref./Text. p. Stress "current leads voltage"

LEVEL II

Unit: 4 INTRODUCTION TO THE NEC AND STANDARDS

Major Objective: To utilize the NEC in wiring practices.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Purpose of the NEC	State the purpose of the NEC.	Lecture Ref: NEC, p. 1 Art. 90-1
b. Scope	Identify those areas that are covered and those that are not covered by the NEC.	Lecture Ref: NEC, p. 1-2, Art. 90-2
c. Code Arrangement	Explain how the code is arranged and state specific articles used in general wiring practices.	Lecture Ref: NEC, p. 2, Art. 90-3
d. Definitions	Define terms used in the NEC which pertain to residential wiring.	Lecture Ref: NEC, p. 4-15, Art. 100
e. Fundamental rules	State the difference between mandatory and recommended rules and its application.	Lecture Ref: NEC, p. 16, Art. 110

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
f. Interpretation	State procedure for filing for a formal code interpretation.	Lecture Ref: NEC, p. 2, Art. 90-5
g. Enforcement	Name the agency who does the enforcement of the NEC in their area.	Lecture Ref: NEC, p. 2, Art. 90-5
h. Examination of Equipment for safety	List two agencies who does examination of equipment.	Lecture Ref: NEC, p. 2, Art. 90-6
i. Wiring Planning	State reasons for adequate wiring planning.	Lecture/discussion Ref: NEC, p. 3, Art. 90-7
j. Revision of the NEC	State how often the Code is revised and the general purpose of revisions.	Lecture/discussion
k. History of the NEC	Discuss the origin and history of the NEC.	Student Assignments.

LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 5 ELECTRICAL BLUEPRINT READING AND CALCULATIONS

Major Objective: Explain the procedures for calculating the number of lighting circuits required for a residential dwelling.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Introduction to blueprint reading	State the purpose of the blueprint. Identify symbols found in blueprints.	Lecture/discussion Ref./Text. p. 25-65 Use real blueprints
b. Material description	Identify the types of materials used.	Lecture/discussion Ref./Text. p.
c. Scales	Identify the scale used on a blueprint.	Lecture/discussion Ref./Text p.
d. Types of drawings.	State the different types of drawings found in a set of blueprints.	Lecture/discussion Ref./Text. p. Plot plan floor plan/elec. plan Elevation Foundation Details

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
f. Calculation	Use the NEC to calculate various types of loads used in residential wiring.	Lecture/discussion Ref./Text p. NEC Chapter 9 Ex. B-1 p. 589 student application-Use floor plan. Lighting loads, small appliance, washers

LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 6 ELECTRICAL TERMINATION

Major Objective: Demonstrate and apply the various types of terminations used in electrical installations.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Types of splices	List the various types of splices used in electrical installations.	Lecture/demonstration Ref./Text p. 147-173 Illustrations
b. Reinsulating	Explain the process used in reinsulating splices.	Lecture/demonstration Ref./Text p. 160-161
c. Use of soldering irons and soldering guns	Demonstrate the techniques of soldering splices.	Lecture/demonstration Ref./Text p. 151-153
d. Use of crimping tools	Demonstrate the use of the crimping tool.	Lecture/demonstration Ref./Text p. 148-149
e. Preparing conductors for termination	Prepare conductors for splicing	Lecture/demonstration Ref./Text p. 147 Stress preventing knicking conductors.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
f. Use of terminal clips	State the reasons for using terminal clips	Lecture/display Ref./Text p. 171-173 Stress: ease of attachment, limited space, saves time.
g. Use of wire nuts	Determine, select and apply the proper size of wire nuts to a pigtail splice.	Lecture/demonstration Ref./Text p. 161-163 Stress: clockwise rotation, no bare conductors, tightness of wire nut.
h. Use of split-bolt connectors	State where split-bolt connectors are most frequently used and demonstrate ability to install split-bolt connectors.	Lecture/demonstration Ref./Text p. 164-166 Stress; proper reinsulating techniques.

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LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 7 ELECTRICAL DIAGRAMS

Major Objective: Utilize proper electrical symbols when drawing electrical diagrams.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Use of diagram	State the use of a wiring diagram and a schematic diagram.	Lecture/illustration Ref./Text p.
b. Symbols	Draw and identify various symbols used in residential wiring.	Illustrate and explain single pole switch three-way switch four-way switch wire connection lampholder junction box pilot lite Ref./Text p. HO 1
c. Single pole switch	Construct a diagram of a single pole switch controlling one or more lites.	Lecture/diagram/discussion Ref./Text p. 111-112 HO 1

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
d. Three-way switching	Construct a diagram using two three-way switches controlling one or more lites.	Lecture/diagram/discussion Ref./Text p. 115-121 HO 9
e. Four-way switching	Construct a diagram using two three-way and one four-way switch to control one or more lites.	Lecture/diagram/discussion Ref./Text p. 121-124 HO 10
f. Lighting circuit	Construct a diagram of a lighting circuit utilizing single pole, three-way, four-way switches and lights.	Lecture/diagrams/discussion Text/Ref. p.
g. Combination switch and pilot light	Construct a diagram of a switch with pilot light.	Lecture/diagram/discussion Ref./Text p. 130-132

LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 8 ELECTRICAL WIRING DEVICES AND MATERIALS

Major Objective: Select and explain the use of electrical wiring devices and materials

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Definition	Define and describe the difference between wiring devices and materials.	Lecture/discussion Stress: material overall term. Device Art. 100
b. Switches	Explain the function of a switch and name three types of switches used in residental wiring.	Lecture/discussion/display Ref./Text p. single pole, three-way four-way switches
c. Receptacles	Explain how receptacles are classified.	Lecture/display/discussion Ref./Text p. NEC Art 410 L
d. Lampholders	State the requirement for screw-shell type lampholders.	Lecture/display NEC Art. 410-47

LEVEL II UNIT 8 ELECTRICAL WIRING DEVICES AND MATERIALS

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
e. Junction boxes	State how boxes are classified and utilized.	Lecture/display Ref./Text p. NEC Art. 370-2, 3, 4 Table 370-6(a)
f. Panelboards	Define panelboard	Lecture/display Ref./Text p. NEC Art. 100, Art .384
g. Conductors	Utilize the NEC to indicate by trade name various conductors and its application.	Lecture NEC Table 310-13
h. Cables	State the use of various types of cables.	Lecture/display/discussion Ref./Text p. NEC Art. 336, 333, 338, 339
i. Raceways	Specify the types of raceways most commonly used in residential wiring.	Lecture/field trip NEC Art. 346, 347, 348 Ref./Text p.
j. Cords	Utilize the NEC to select cords and cables for specific applications.	Lecture/display NEC Table 400-4 Ref./Text p.
k. Attachment caps	Identify attachment caps and install/attach to flexible cords.	Lecture/demonstration Ref./Text p.
l. Fasteners	List the various types of fasteners used in electrical wiring.	Lecture/display Ref./Text p. Stress: wood screws sheetmetal screws, lag screws, machine screws, stove bolts, power fasteners.

LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 9 OVERCURRENT PROTECTION

Major Objective: Explain the purposes and principles of overcurrent protection.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. purpose	State the purpose of installing overcurrent protection in circuits.	Lecture/discussion NECT Art. 240 Ref./Text p. 282
b. Types of overcurrent protection	Identify various types of overcurrent devices.	Lecture/display Transparency 3 & 4 Ref./ Text p. 282-286
c. Selection	Utilize the Code to select the proper rated overcurrent device to protect a given size conductor.	Lecture/discussion NEC Art. 310 p. 132-135 Ref./Text p. 286
d. Usage	State the proper type of overcurrent protection for given circuit.	Lecture/disussion NEC Art. 240-8, 50, 51, 52, 53, 54, 60, 61, G.

LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 10 WIRING METHODS

Major Objective: Apply wiring methods recognized by the code

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Raceways	State two types of raceways	Lecture/display Ref./Text p. 320-323 Stress: metallic and non-metallic
	Name the type most commonly used in residential wiring.	Lecture Non-metallic (PVC)
	State the minimum trade size of PVC	Lecture NEC Art 347-10 (½")
	State the number of bends allowed in each run of raceway. (Maximum)	Lecture NEC Art 347-13 (4 ¼ bends)
	Connect or join PVC	Lecture/demonstration Ref./Text p.
	Bend PVC by using heat	Lecture/Demonstration Ref./Text p.

LEVEL II UNIT 10 WIRING METHODS

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
A. Raceway	Name the fittings used with PVC	Lecture/display Stress: adapters, couplings
	Name other materials used with PVC	Lecture/display Stress: straps, locknuts, bushing, condulets, boxes, and covers
	Use the NEC to determine size of raceway and number of conductors that can be inserted into the raceway.	Lecture NEC Art 347-11, Table 1 Chapter 9
	Name other types of raceways	Lecture Ref./Text p. NEC Chapter 3 Rigid conduit, EMT, flexible conduit
b. Cables	Define the term "cable"	Lecture/Display NEC 100 Ref./Text p. 76-87
	Using the NEC state the article which covers NM cable.	Lecture NEC Art 336
	Demonstrate ability to install wiring using NM cable.	Lecture/demonstration Have student install wiring using NM cable
c. Selection and application of wiring methods	Use the NEC to select the correct wiring methods for either a concrete block dwelling or wooden structure.	Lecture NEC (Use not permitted and permitted)

LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 11 GROUNDING

Major Objective: DETERMINE THE Proper size conductor for grounding an electrical system.

Determine the proper size conductor for grounding equipment.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Purpose	Explain why electrical systems and equipment are grounded.	Lecture/discussion NEC Art. 250 Ref./Text p. 295
b. Types of grounding	State the different types of grounding utilized in residential wiring.	Lecture/discussion NEC Art 250 - 5, E-42, 43, 44, 45 Ref./Text p. 295-299
c. Methods of grounding	Discuss and explain two different methods of grounding.	Lecture/discussion NEC Art 250-F Text p. 299-305
d. Bonding	Explain the purpose of bonding and draw a diagram of bonding a distribution panel and service.	Lecture/diagram/discussion NEC Art. 250-53b, 250-G Ref./Text p. 305-312

LEVEL II UNIT 11 GROUNDING

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
e. Selecting grounding and bonding conductors	Select the proper size conductor for grounding and bonding a residential service system using the NEC.	Lecture/explanation NEC Art. 250-94, 250-95 Ref./Text p.
f. NEC requirements	Utilize the NEC to determine when and how to ground and bond services and equipment.	Lecture/discussion NEC Art. 250

LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 12 ELECTRICAL SERVICE SYSTEM

Major Objective: Determine and select the proper materials for a service entrance.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Types of services	Name two types of residential services.	Lecture/discussion/diagram Single phase, two wire Single phase, three wire Voltage: 115/230 or 120/240 Ref./Text p. 255, 279
b. Parts of the service	List the parts of an electrical service entrance.	Lecture/transparency Service entrance cap/head Service mast (pipe) Meter base (socket) Ref./Text p. 256-266
c. Calculating service	Determine or compute the required rating of a service entrance.	Lecture/illustration NEC Art. 230-41b (1), (2) Chapter 9 example #1

LEVEL II UNIT 12 ELECTRICAL SERVICE ENTRANCE

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
d. Selecting service entrance materials	State the materials used for service entrances.	Lecture/display Entrance head/cap Conduit Connectors and fittings Meter base Condulets Conduit straps *Insulator Conductors Ref./Text p. 263, 274,-277
e. Installing services	Assemble materials and install a service entrance.	Lecture/demonstration Ref./Text p. TM ____ / HO 3
f. NEC requirement	Complete an exam on services with 80% correct.	Lecture NEC Art. 230

LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 13 TROUBLESHOOTING PROCEDURES

Major Objective: Analyze basic wiring problems in lighting circuits and correct them.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Analyze electrical diagrams	Read and interpret schematic and wiring diagrams and trace current flow.	Lecture/diagram schematic and wiring diagram Ref./Text p.
b. Determine malfunction	Select the proper meter or tester to identify malfunction or disorder.	Lecture/review test instruments. Ref./Text p. Build/wire defective circuit
c. Restoring problem	Prescribe repair or replacement of circuit component.	Lecture/demonstration Ref./Text p.
d. Retest	State the procedure for safely retesting a defective circuit.	Lecture/demonstration List procedure Ref./Text p.

COURSE OUTLINE LEVEL III

LEVEL III

A. COURSE TITLE: ELECTRICAL APPLICATIONS AND INSTALLATIONS

B. COURSE DESCRIPTION

This final course covers the planning and designing of electrical circuits which are applied to residential dwellings. Some job acquisition skills are also taught to prepare students for employment.

Raceway wiring practices and techniques as well as testing, and analyzing electrical circuits are stressed in shop practice.

C. GOALS

The goal of this course is to prepare the student for entry level employment in the residential wiring industry. Safety practices as well as occupational skills, attitudes, and future employment trends are stressed.

D. COURSE OBJECTIVES

Upon completion of this course, the student will be able to:

1. Practice safety procedures used in industry
2. Plan and layout electrical circuits for a residential dwelling
3. Examine and explain the use of various electrical systems
4. Apply the requirements of the NEC to residential wiring
5. Select and install wiring devices and materials
6. Prescribe the type of fixtures for specific locations and their classification
7. Analyze an existing lighting circuit and recommend procedures to alterate the lighting control
8. Explain the purpose of acquiring good job acquisition skills
9. Select a project to develop awareness in other electrical occupations
10. Acquire up-to-date information on subjects that are related to the job market and future trends.

E. COURSE OUTLINE

1. Safety

   a. Accident prevention

b. Equipment grounding
c. Safety rules

2. Planning and Laying Out Electrical Circuits

a. Blueprint reading
b. Interpreting electrical specifications
c. Interpreting electrical symbols
d. Single-family dwelling calculations
e. Wiring methods
f. Code requirements

3. Electrical System Analysis

a. Types of systems
b. Applications
c. Schematic diagrams

4. Advanced Interpretation of the National Electrical Code

a. Use of tables and examples
b. Wiring methods and materials
c. Equipment for general use
d. References and guides

5. Wiring a Residential Unit/Dwelling

a. Locating lighting outlets
b. Locating receptacle outlets
c. Locating appliance outlets
d. Locating switch outlets
e. Rough-in wiring (installing raceways and conductors)
f. Installing devices and cover plates
g. Installing services
h. Installing panelboards and circuit breakers
i. Installing lighting fixture
j. Testing and evaluating wiring

6. Lighting Fixtures

a. Types of fixtures
b. Selection and application
c. Types and ratings of light bulbs/lamps
d. Automatic controls
e. Installing fixtures
f. Code requirements

7. Renovation and Troubleshooting

   a. Differentiate between alteration, repair, and new work
   b. Selecting proper materials
   c. Rearranging lighting controls
   d. Code requirement
   e. Terms and definitions

8. Job Acquisition Skills

   a. Job application process
   b. Developing a resume
   c. Future educational goals/Postsecondary education

9. Advanced Electrical Wiring

   a. Repairing small appliances
   b. Repairing large appliances
   c. Troubleshooting procedures
   d. Individual projects

10. Guest Speakers

   a. Government
   b. Industry
   c. Business
   d. Others

11. Field Trips

   a.
   b.
   c.

F. METHOD OF EVALUATION

1. Written Examination
2. Oral
3. Attendance
4. Performance
5. Classroom Participation

G. TEXT AND REFERENCES

1.
2.
3.

H. CLASSROOM EQUIPMENT

1. Overhead Projector
2. 16 mm Projector
3. Colored chalk

LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS

Unit: 1 SAFETY

Major Objective: Practice safety procedures used in industry

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Accident prevention	Identify unsafe/hazardous equipment and prescribe corrective measure.	Lecture/demonstration Visual aid (if available)
b. Equipment grounding	Discuss the importance of grounding equipment and methods used to ground equipment.	Lecture/demonstration Ref./Text page 296-299
c. Safety rules	List as many safety rules which will prevent accidents.	Lecture/handout Ref./Text p. TM ____

LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS
Unit: 2 PLANNING AND LAYING OUT ELECTRICAL CIRCUITS

Major Objective: Plan and layout electrical cirucits for a residential dwelling

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Blueprint reading	Able to discuss the importance of blueprint reading for electricians.	Lecture/discussion Ref./Text. p. 25
b. Interpreting electrical specification	State the reasons for having a set of specification.	Lecture/discussion Ref./Text. p. 63
c. Interpreting electrical symbols	Discuss and identify the electrical symbols used in blueprints.	Lecture/discussion Ref./Text. p. 26
d. Single-family dwelling	Estimate the number of circuits required for a dwelling and layout the required number of outlets.	Lecture/discussion Ref./Text. p. 38 NEC Chapter 9 Example 1 Floor plan HO 11
e. Wiring methods	Select wiring methods for both concrete and wooden structures.	Lecture/discussion NEC art. 336, 347, 346, 348, 339
f. Code requirements	State the code articles that pertains to electrical circuits and layout.	Lecture/discussion NEC Art. 210, 220.

LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS

Unit: 3 ELECTRICAL SYSTEM ANALYSIS

Major Objective: Examine and explain the use of various electrical systems.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Types of systems	Explain the difference between a single-phase and three-phase electrical system.	Lecture and diagram/ Ref./Text. p. Load requirement
b. Applications	State when and where single-phase and three-phase systems are utilized.	Lecture/discussion Ref./Text. p. Residential/Commercial, Industrial
c. Schematic diagrams	Draw a schematic diagram of a single-phase and three-phase system with voltages.	Lecture/discussion/ diagrams. Ref./Text. p.

LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS

Unit: 4 ADVANCED INTERPRETATION OF THE NATIONAL ELECTRICAL CODE

Major Objective: Apply the requirements of the NEC to residential wiring

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Use of tables	Select the tables for sizing grounding conductors, conduit fill, conductor fill for boxes.	Lecture/discussion NEC Tables 250-94 250-95 3A Chapter 9 370-6(a)
b. Wiring methods and materials	List the wiring methods approved for residential wiring and the basic materials Name the code articles that covers the materials listed above.	Lecture/discussion review methods and materials NEC Art. 370, 380, 384, 410
c. Equipment for general use.	List those articles which pertains to residential wiring.	NEC Chapter 4 Read and discuss
d. References and guides	List at least two references and guides that would aid an electrician to interpret the NEC.	Lecture/discussion Guide to the NEC., Audel Electrical Construction and Maintenance, National Electrical Code Handbook.

LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS

Unit: 5 WIRING A RESIDENTIAL UNIT DWELLING

Major Objective: Select and install wiring devices and materials.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Locating lighting outlets	Identify various types of lighting outlets and locate outlet on framed structure.	Review symbols/Demonstration Read blueprint Use tape rule, climb ladder
b. Locating receptacle	Identify receptacle symbols and locate outlet on framed structure.	Review symbols/demonstration read blueprint use tape rule
c. Locating appliance outlets	Identify appliance outlets and locate on framed structure.	Review symbols/demonstration read blueprint, use tape rule.
d. Locate switch outlets	Identify switch symbols and locate outlet on framed structure.	Review symbols/demonstration read blueprint, use tape rule.
e. Rough-in wiring	Select proper size PVC and install to outlet boxes	Lecture/demonstration Use of hack saw, glue, adapters, raise covers. Ref. Text. p.. 83,94

LEVEL III UNIT 5 WIRING A RESIDENTIAL UNIT DWELLING (continued)

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
e. Rough-in wiring	Determine conductor fill for boxes and conduits.	Lecture NEC Chapter 9 Table 3A Art. 370 Table 370 6(a)
f. Installing devices and cover plates	Select proper devices and cover plates and install same.	Lecture/demonstration/ display Ref./Text. p. 26-28 NEC. Art. 370-15
g. Installing services	Describe procedure in installing services.	Lecture/Demonstration Ref./Text. p. 255-294 Stress bonding and grounding NEC Art. 230-2, 22, 24, 26, 41, 46, 71, 79(c)
	List the materials used in a mast type service.	Lecture/display Ref./Text. p. 262, 263
h. Installing panelboard and circuit breakers.	Mount a panelboard and install circuit breakers.	Lecture/demonstration Ref./Text. p. 272-279 NEC. Art. 384-7, 15, 16, 27
i. Installing lighting fixtures.	Install fixtures used in dwellings	Lecture/demonstration Ref./Text p. NEC Art. 410-8, 12, 13, 15, 16, 17, 23, 26, 27, 28, 30, 31
j. Testing and evaluating	Test wiring which are free from shorts or grounds and passes an inspection by the instructor.	Lecture/demonstration Ref./Text. p. 405-407 All installations to be done in shop.

LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS

Unit: 6 LIGHTING FIXTURES

Major Objective: Prescribe the type of fixtures for specific locations and their classification

Text: Electrical Construction
Ref : NEC
House Wiring Simplified

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Types of fixtures	List five different types of fixtures	Lecture/display recess, surface mounted, Vapor proof, weather proof, incandescent, fluorescent, mercury vapor.
b. Selection and application	State the procedure to use in selecting fixtures for specific location and applications.	Lecture/discussion Ref./Text. p. 425 NEC. Art. 410-4
c. Types and ratings of light bulbs	List the types and manner in which light bulbs are rated.	Lecture/display Ref./Text. p. 129-132
d. Automatic controls	List two types of automatic control devices used for lighting.	Lecture/display photo-cell time switch

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
e. Installing fixtures	Install and hook-up fixtures to lighting outlets.	Lecture/demonstration Ref./Text. p. 87
d. Code requirement	State the code requirement for installing fluorescent fixtures, closet fixtures, and recess fixtures.	Lecture/demonstration NEC Art. 410-31 410-8 410-66

LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS

Unit: 7 RENOVATION AND TROUBLESHOOTING

Major Objective: Analyze an existing lighting circuit and recommend procedures to alter the lighting control.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Differentiate between alteration, repair, and new work.	Define terms used in alteration/renovation in electrical wiring. Discuss the difference between alteration, repair, and new work.	Lecture/demonstration Ref./Text. p. 405-437
b. Selecting proper materials	Select and identify by trade name materials used in electrical wiring.	Lecture/discussion Ref./Text p. 408-434
c. Rearranging lighting controls	Analyze a single pole switching circuit and recommend procedure in changing the switching arrangement to control the lite from two locations.	Lecture/diagram Stress wiring diagrams and schematic diagrams, conductor fill.
d. Code requirement	Identify code articles that would be used in the above objectives.	Lecture/discussion NEC Table 370-6(a), Chapter 9 Table 3A
e. Terms and definitions	Define terms and definitions used in renovation wiring.	Lecture/discussion

LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS

Unit: 8 JOB AQUISITION SKILLS

Major Objective: Explain the purpose of acquiring good job acquisition skills

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Job application process	Fill out samples job application forms	Lecture/explanation Application form: Civil Service, Telecommunications Corp. Saipan Cable T.V. Co. Saipan Continental
b. Developing a resume	Complete a resume	Lecture/explanation Handout sample resume #17
c. Future educational goals/postsecondary education	Make a rational choice whether to continue their education and name a few schools that would provide the type of education to satisfy their needs.	Lecture Guest speaker MOC UOG HAWCC HONCC

LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS

Unit: 9 ADVANCED ELECTRICAL WIRING

Major Objective: Select a project to develop awareness in other electrical occupations

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
a. Repairing small appliances	Describe what a small applicance repair-person does. Select the proper test instrument to be used in repairing small appliances.	Assignment by instructor Ref. DOT Individual instruction by instructor. Ref. Home Appliance Servicing. Anderson, Edwin P. Small Appliance Repair Guide. Vol. 1, Lemons, Wayne and Montgomery
b. Repairing Major appliances	Describe what a major appliance repair-person does. List by names appliances which are considered as being major appliances.	Assignment by instructor Ref. DOT Lecture/discussion Ref. Home Applicance Servicing. Anderson, Edwin P Major Appliance Repair Guide, Lemon & Price

LEVEL III UNIT 9 ADVANCED ELECTRICAL WIRING

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
c. Troubleshooting procedures	Describe and read troubleshooting procedures.	Lecture/discussion Ref. Home Appliance Guide-p. 68-91
	Apply procedures in repairing a major appliance.	Project assigned by instructor.
d. Individual projects	Select an activity in appliance repair.	Student/instructor agreement. Stress: Work habits, safety, responsibility, neatness.

APPENDICES

APPENDIX A JOB DESCRIPTION

JOB DESCRIPTION:

RESIDENTIAL ELECTRICIAN

The residential electrician performs repairs and maintains existing wiring in a residential structure. The electrician is responsible for the layout of new residential wiring, the calculation and installation of branch circuits, and other basic circuits. The electrician also installs proper size service entrance, installs electric heating and cooling if required, and installs all electrical devices used in a residence. This work is performed in a neat and workman-like manner to conform to local and National Electrical Code requirements.

In the process of performing these tasks, the electrician uses a basic set of handtools which are held in a tool pouch, hand held electric drills, an assortment of drill bits, extension cords, test instruments, ladders, hack saws, keyhole saw, fastening devices, etc.

The electrician works in cramped places, under buildings, on scaffoldings and ladders, both indoors and outdoors.

APPENDIX B RESIDENTIAL WIRING TASKS

RESIDENTIAL WIRING TASKS

1. Read and interpret electrical plans and specifications
2. Layout general purpose receptacle outlets
3. Layout switch outlets
4. Layout lighting outlets (wall brackets)
5. Layout appliance outlets
6. Layout signal circuit outlets (low voltage)
7. Layout panelboard location
8. Layout route for raceways and cables
9. Install raceways and fittings
10. Install and set receptacle boxes
11. Select, install and set switch boxes
12. Select, install, and set appliance boxes
13. Select and install panelboard
14. Layout ceiling lighting outlets
15. Install raceways to lighting outlets and switch points
16. Select, and install raceways for branch circuits
17. Layout service equipment and feeder
18. Select and install raceways for service and feeder
19. Select proper size wire and pull wires for outlets and branch circuits
20. Select proper size wire and pull wires for service and feeder
21. Splice and terminate all conductors
22. Select and install switches and receptacles
23. Install circuit breakers in panelboard and tie-in branch circuits
24. Select and install fixtures
25. Select and install cover plates
26. Select and install system ground conductor
27. Install push button and chimes (signal equipment)
28. Install panelboard cover
29. Test all circuits and balance load in panelboard
30. Label circuits in panelboard
31. Call for or apply for service drop and meter

Note: All wiring to be coordinated with other building trades occupations.

All wiring is approved by the power company before service is energized.

APPENDIX C SAMPLE LESSON PLAN

LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 2 SHOP ORIENTATION

Instructor Plan

Student Objectives:

a. Discuss various aspects of rules and regulations of the shop and classroom.

b. Assess what is to be learned in the program of study.

c. Determine methods used in grading.

d. Make maximum use of learning resources.

e. Identify areas that are used as aisles, work-stations, construction areas, tools and material storage.

f. Identify area designated as tool room and state procedure in acquiring tools for shop use.

1. Shop Policy:

   Shop rules
   Starting and ending hours/time
   Smoking prohibited in shop
   Absence
   Tardy
   Illness
   Personal hygiene
   Cooperation
   Student conduct
   Advising and counseling

2. Introduction of Course Content:

   Discuss course content
   Course objectives
   Text and references
   Courses for further studies

3. Grading Policy:

   Written examination
   Classroom participation
   Attendance
   Assignments/homework
   Shop practice/lab.

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4. Location of Books and References:

   Classroom
   Library
   Borrowing policy

5. Shop Layout:

   Tour of shop
   Tool room
   Toilet
   Drinking fountain
   Work bences
   Construction wiring area
   Shop exits

6. Location of Tools:

   Handtools located in tool room
   Tool check out policy
   Student responsibility

LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 3 SAFETY

Instructor Plan

Student Objectives:

a. Pass an examination on safety with 100% accuracy.
b. List the emergency first aid procedure.
c. Explain how improper ventilation and lighting can be hazardous to work condition.
d. Develop proper lifting skills and procedures for handling chemicals.
e. Identify the location of the nearest fire extinguisher and state type of fire it can be used on.

Introduction:

Safety should be a concern of everyone. Your interest in safety includes that of protecting yourself and others from injury. Much emphasis is given to safety in all sectors of society. "Accidents don't just happen; they are cuased". In times past, people frequently considered accidents as inevitable or "acts of God". Today this concept is no longer acceptable as a way of explaining accidents. A safety minded person has a perception of existing hazards. Preparation must be made for protection and to prevent accidents precautions must be taken.

1. Safety Program

   1.1 Attend seminar on Safety Program
   1.2 Guest speaker on safety
   1.3 Have students observe posters in classroom and shop and have discussion on these posters

2. First aid

   2.1 Emergency first aid procedure

      a. Call doctor or ambulance #_____, #_____.
      b. Inform instructor of accidents. Large or small

   2.2 Demonstration by fire department (First aid)

3 Ventilation and Lighting

3.1 Ventilation

a. Open windows and doors before working
b. Turn on fans if available
c. Close all windows, louvers, and doors when work has ended
d. Turn off fans if applicable

3.2 Lighting

a. Turn on all lights when beginning class/shop work
b. Inform instructor if lights are not operable
c. Provide for portable lighting when more lights are desirable
d. Be sure that lights on electrical tools are in good working condition

4. Material Handling and Storage

4.1 Avoid injury by not lifting too heavy an object
Push, pull, roll, or slide when possible
If object is over 25 pounds, get assistance
Develop proper lifting skills
Always wear shoes
If more than one persons is lifting the object, work as a team
Demonstrate carrying.....pack a box with about 25 lbs. of books
Check your footing. Avoid slippery or hazardous areas
Spread your feet slightly (comfortable) with one foot slightly forward and along side of object.
Bend knees, kneel or squat
Do not bend back to reach for load
Get close to object being carried
Use blocking under objects to provide hand space..demonstrate
Get a firm grip..use gloves when handling sharp objects..demonstrate
Let your legs do the lifting....demonstrate
Shift the feet to turn...demonstrate

To lower load, bend the knees, keep the back straight, and use legs and arms to lower the load
When moving long objects, check that the area is clear of obstructions, persons, and co-workers
Film, if available

4.2 Chemicals
Check with instructor before using any chemicals or solvents
Avoid contact to skin
Wear rubber gloves or plastic gloves
Use face shield
Do not inhale fumes

5. Location of Fire Extinguishers

4.1 Identify location of nearest fire extinguisher _____.
Identify or state type of fire that this fire extinguisher can be used for _____.
Do not play with fire extinguishers.
Always return them at their intended location
Report to instructor if fire extinguisher is not at the proper location

4.2 Types of Fire Extinguishers
Provide students with handouts # 11
Type ABC dry chemical the most commonly used

4.3 Have students state types of fires and type of extinguisher to be utilized. Use handouts.

NAME:_____

DATE:_____

GRADE:_____

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 3 SAFETY

TEST

In the space provided at the end of each statement, write a T if the statement is True and F if the statement is False.

1. When someone in the shop has an accident, you should notify your principle first. ___

2. Portable first aid kits are provided to apply simple aid to minor cuts or burns. ___

3. The purpose of the exhaust fans are to circulate the air in the shop. ___

4. When using stationary power tools in the shop such as a drill-press or grinder, it is not desirable to have lighting at each tool. ___

5. In carrying and lifting long objects such as conduits or wood consider that no one is around. ___

6. To avoid electrical shock, all ornaments such as rings, watches, chains, and other metal objects should be removed before attempting to work on live circuits. ___

SHORT ESSAYS:

7. List the three-step emergency first aid procedure.

8. List atleast five proper procedures in lifting heavy objects.

9. Name three classes of fires and indicate what causes these fires.

LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 4 USE AND CARE OF ELECTRICAL WIRING TOOLS

Instructor Plan

Student Objectives:

a. Demonstrate the proper use and care of screw drivers.
b. Demonstrate the proper use and care of phillips screw drivers.
c. Demonstrate the proper use and care of knives.
d. Demonstrate the proper use and care of the diagonal pliers.
e. Demonstrate the proper use and care of the long nose pliers.
f. Demonstrate the proper use and care of the lineman's plier.

Introduction:

Importance of use and care of electrical wiring tools.

1. When properly applied, they are time savers.
2. When properly cared for, they are safe to use and prevents accidents.
3. Overall appearance of the job will look acceptable. (Workmanship)
4. Mark of a qualified tradesperson.

a. Screwdriver: Display
Use to install various types of straight slot screws.
Sized according to length of shank and width of tip.
example: OH (overhead transparency)
Insulated handles to prevent electrical shock
Keep handles free of burrs.
Tip should be as wide as the slot of the screw.
Keep tips ground straight and flat (OH)/demonstrate
When installing screws, keep screwdriver level or plumb to prevent slippage. Demonstrate.

b. Phillips screwdriver: Display
Used to install various sizes of phillips screws.
Tip has a tee slot and thus provide more grip and prevents slippage.
Sized according to length of shank and width of tip.
example: OH.
Keep handles free of burrs.
Blades should be kept straight.
When installing screws, keep screwdriver level and plumb to prevent slippage. Demonstrate.

c. Knife: Display
Used to skin or remove insulation from conductors and cables.
Whenever possible, face blade away from body. Demonstrate.
Keep blade sharp to prevent accident as well as achieving maximum advantage.

d. Diagonal pliers: Display.
Used for cutting conductors, cables, stripping insulation, and form loops. Demonstrate.
Keep handles free from oil and grease to prevent slippage
Insulated handle will prevent electrical shock.
Not to be used as a hammer.

e. Longnose pliers: Display.
Used to reach into narrow/tight spaces, form loops, making splices. Demonstrate.
Do not use longnose to tighten large bolts or nuts.
Use insulated handles whenever possible.

f. Side cutting pliers/lineman's pliers: Display.
Used for cutting conductors, cables, and stripping insulation off conductors. Also used to form loops for terminal connections and splicing. Demonstrate.
Keep handles free from oil and grease to prevent slippage.

g. Channel lok pliers: Display.
Used to tighten and remove locknuts and bushings, to install split-bolt connectors, gripping conduits and tubings. Demonstrate.
Adjust opening according to width of work and be able to hold handle with one hand if possible. Demonstrate.
Tighten and loosen objects so that the direction you are turning will provide the greatest grip. Demonstrate.

h. Torpedo level: Display.
Used to level and plumb work. Demonstrate.
Magnetic base will provide a free hand when using a level.
Do not drop level or damage surface.

i. Tape rule: Display.
Used for measuring distances.
Do not leave tape rule opened and laying out.
Recommend 12 feet ruler or longer. Conduits are 10 feet long and you may over extend the rule. Comes in different types of materials and color.
Avoid kinking tape to prevent breakage.

j. Chisels: Display.
Used for notching wood
Keep chisels sharp and handles free of burrs and grease.
Sized according to the width of the cutting blade. Demonstrate.

k. Hammer: Display.
Electrician's or ripping hammer. Claw is less curved than the carpenter's hammer.
Sized according to weight.
Keep hammer head smooth and free of burrs or mushrooming.

l. Keyhole saw: Display.
Used for cutting opening for boxes, notching.
Classified according to type of blade. May be used to cut wood, metal, gypsum board, and fiber boards.
Start cut by pulling back towards you. This may prevent the blade from jumping and cutting your hands or fingers.

m. Wire stripper: Display.
Used to strip insulation off conductors and form terminal loops.
Also used to cut smaller sizes of conductors. Demonstration.

n. Hacksaw: Display.
Used for cutting conduits, cables, metals, woods, and fiberboards.
Blades classified according to the number of teeth/tooth per inch., recommend using 18 or 24 teeth blade for electrical work.
When cutting, keep hacksaw frame straight. Demonstrate.
Pull back when starting any cuts before making forward strokes to prevent saw from jumping and cutting your hands or fingers.

o. Vise grip pliers: Display
Used as a locking pliers to provide a strong grip and prevent slippage.
Take precaution not to damage area where pliers grip.
Keep handles clean and jaws free of debris to prevent slippage.

p. Tool pouch: Display.
Used for carrying handtools.
Made of leather and should be kept from drying out and cracking
Use a leather preservative or saddle soap.
Keep tool points facing in the pouch when carrying tools rather than the points up.

Examination
Application

NAME _____
DATE _____
GRADE _____

TEST

Identify at least 14 of the 16 tools which will be shown to you and state its use.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____

LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 5 SOURCES OF ELECTRICITY

INSTRUCTOR PLAN

Student Objectives:

a. Explain how electricity can be produced by friction.
b. Explain how electricity can be produced by chemical.
c. Explain how electricity can be produced by magnetism.
d. Explain how electricity can be produced by pressures.
e. Explain or give an example of a form of electricity that is produced by light.

a. Friction:

A form of static electric. Can be produced by rubbing two objects together.

Procedure in setting-up an experiment:

1. One piece of silk rag 12" x 12"
2. A glass rod about 12" long
3. Fold silk cloth in half and place rod between silk. Some electrons are transferred from the cloth to the rod, the rod is no longer neutral because it now has more negative electrons than positive protons.
4. Pick-up small bits of paper with the glass rod.
   Triboelectricity
   TM 26

b. Chemical:

The simplest kind of cell consists of two pieces of different metals in a solution.

The pieces of metals are called electrodes.
These electrodes must be of different metals.
The solution is called an electrolyte.
The electrolyte must be a conductor of electric current.
It must have a chemical action with one of the electrodes.

Another type of battery is called the storage battery or secondary cell

Procedure in setting-up an experiment:

1. A glass jar

2. A copper bar and a zinc bar
3. Sulfuric acid and water. NOTE: MIX ACID INTO WATER TO PREVENT RAPID CHEMICAL ACTION.....(H2S04)
4. Use galvanometer to test voltage.
   TM 27

c. Magnetic:
The simplest form of magnetic/mechanical means of producing EMF is by mving a magnet into a coil of wire. THE GENERATOR

Procedure in setting-up an experiment:

1. a bar magnet
2. Ten feet of copper conductor, #16 or smaller formed into a loop wide enough to move the bar magnet into. Skin both ends of the loop.

3. Connect ends of loop to galvonameter or sensitive volt meter.
4. Slide magnet into loop and note needle deflection on meter.
5. You have now produced EMF by using a magnet.

d. Pressure:

Electricity is produced when pressure is applied to a crystal. Substance such as quartz, tourmaline, and Rochelle salts are good examples of electrical charges.

1. A piece of crystal
2. A metal plate
3. Insert the crystal between the metal plate and move the crystal back and forth. Note results
4. Connect leads to galvanometer.
   TM 28

e. Light:

The simplest form is a photo cell which utilizes selenium to produce EMF which in turn energizes a contact to open and close the circuit of the photo cell to control lites or other apparatus.

Procedure in setting-up an experiment:

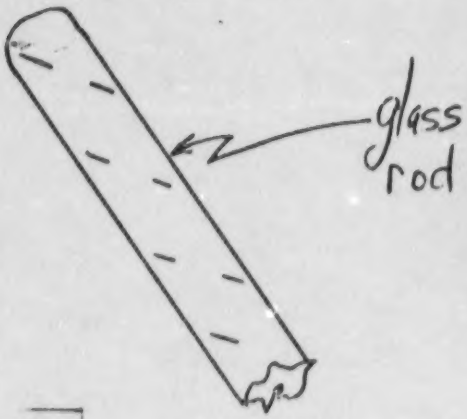
1. Selenium, iron and translucent window.
2. Insert the selenium in between the iron and translucent window.
3. Apply light through the translucent window.
4. Connect galvanometer to leads and note reaction.
   TM 30

f. Heat:

The simplest form is a thermocouple. Connecting two different types of metals and applying heat to the joint will produce EMF.

Procedure in setting-up an experiment:

1. A piece of copper wire
2. A piece of zinc
3. Candle/Flame
4. Combine both the copper and zinc and connect ends to a galvonometer.
5. Heat the joint with the candle and note meter movement.
   TM 29



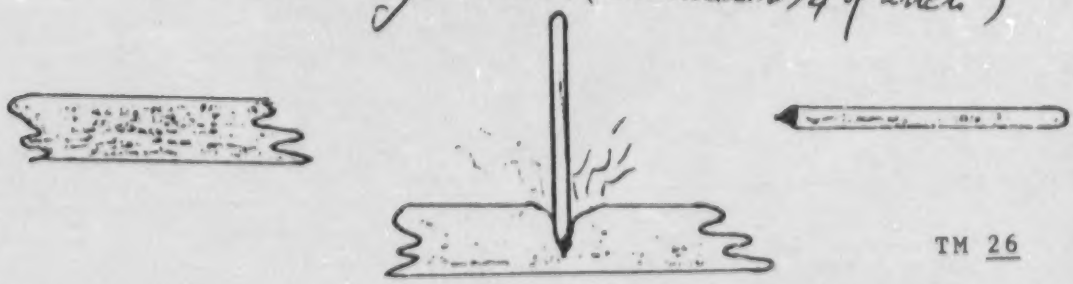
Triboelectricity

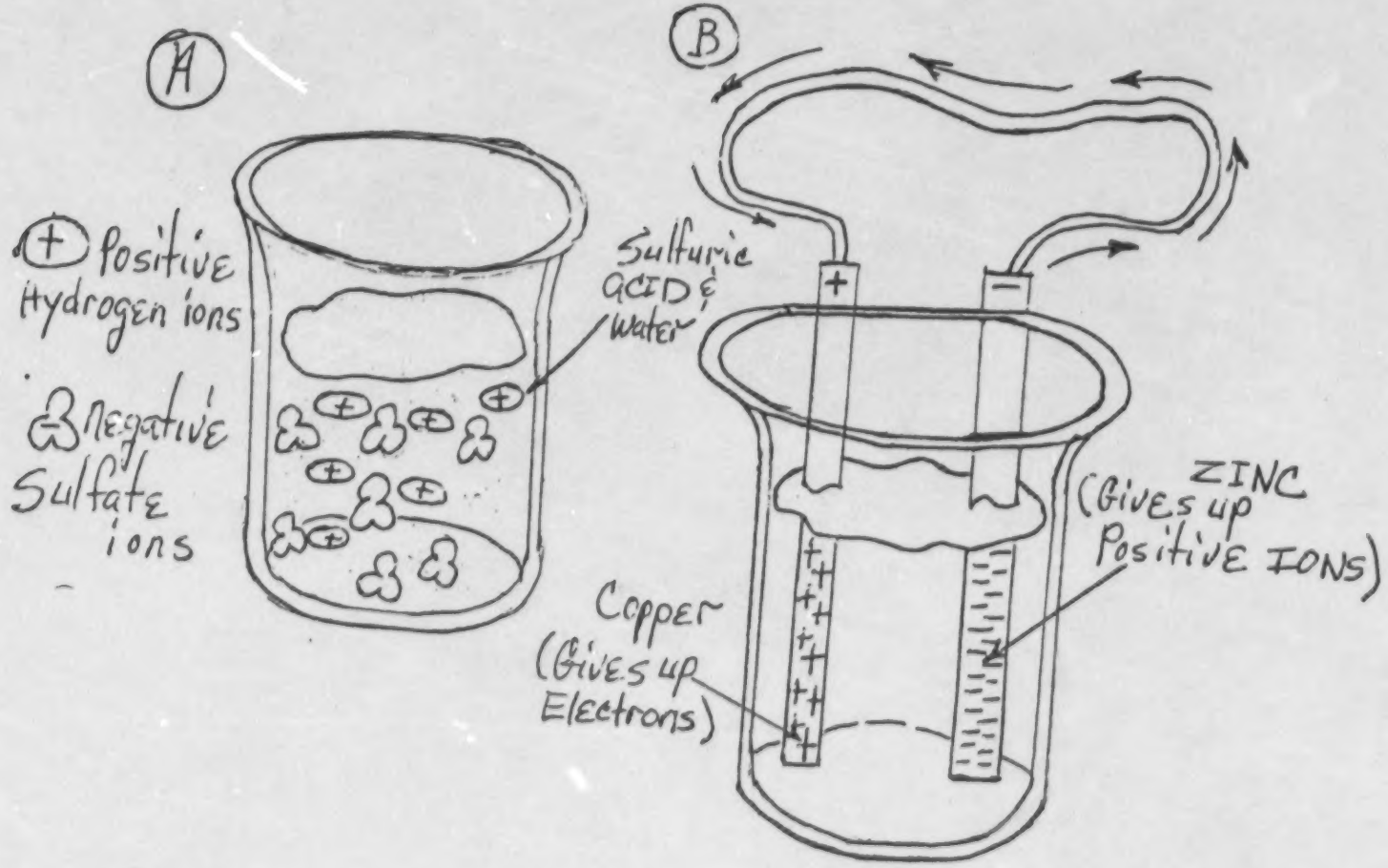
Note: After the glass rod and silk are rubbed together, they become charged with electricity.

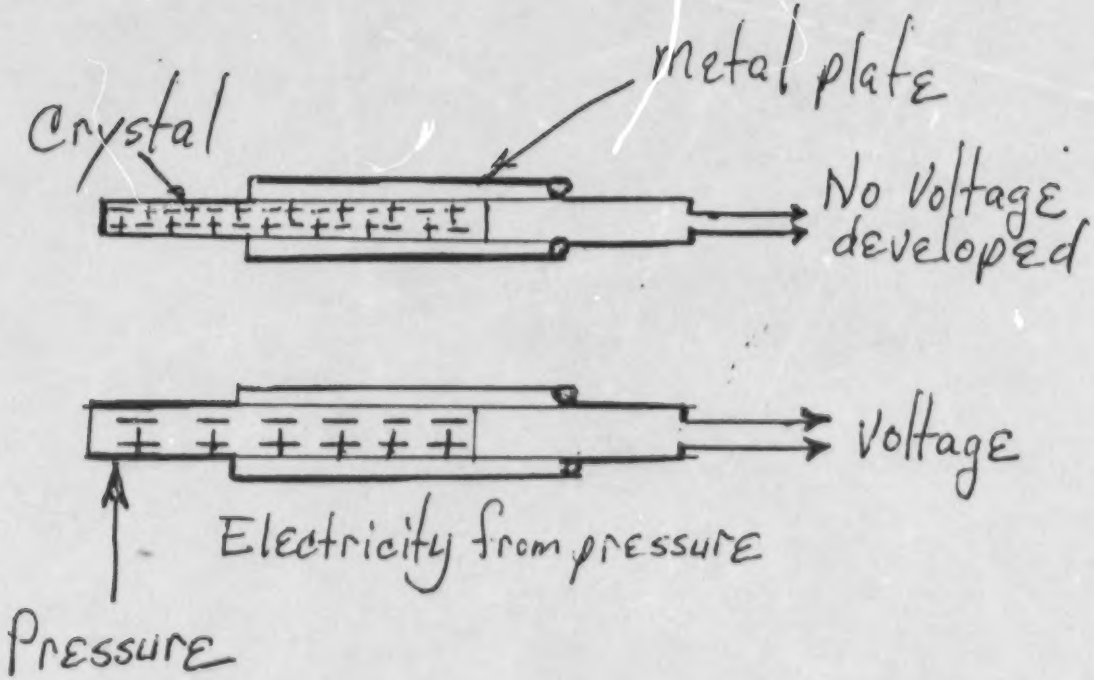
Another method of producing friction:

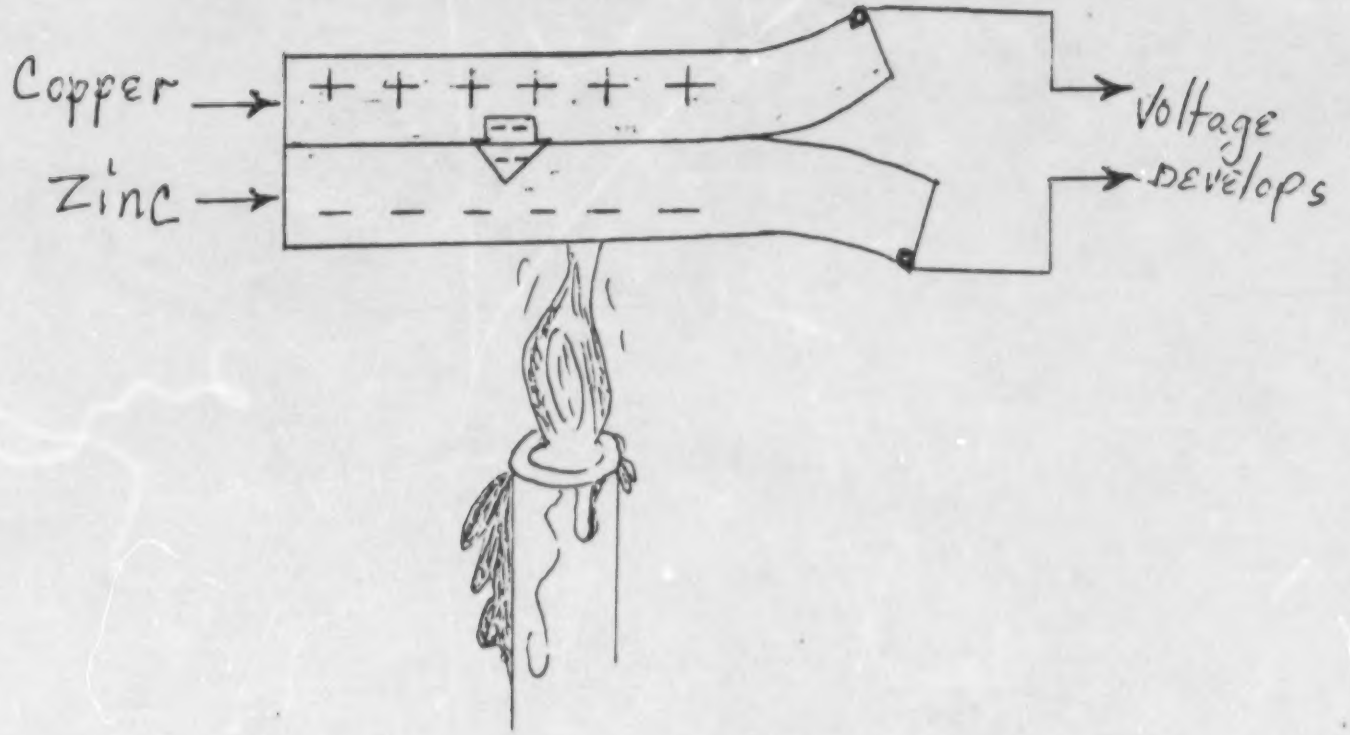
Piece of wood (soft type. work harder)

One 12 inches long wood (diameter ¼ of inch)

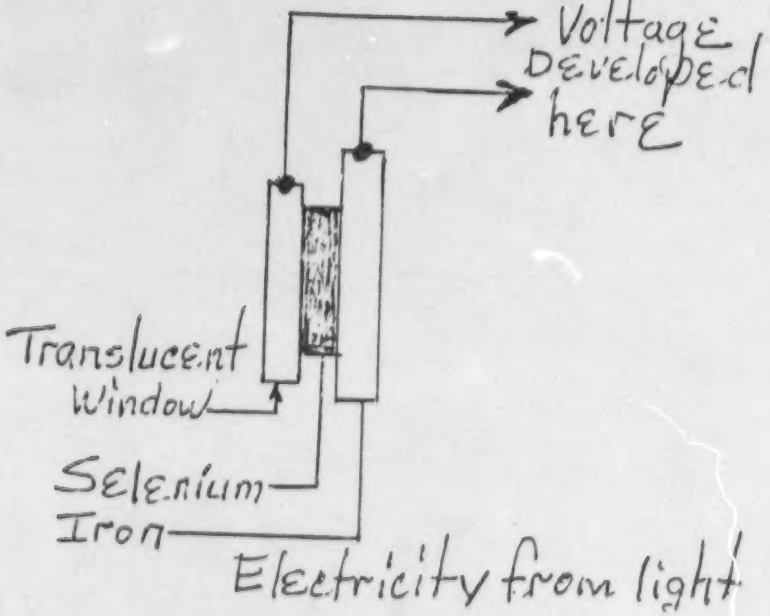



A
B
Positive Hydrogen ions
Negative Sulfate ions
Sulfuric ACID & water
+
−
ZINC (Gives up Positive IONS)
Copper (Gives up Electrons)


metal plate
Crystal
No voltage developed
Voltage
Electricity from pressure
Pressure



Electricity from heat


Voltage
Developed
here
Translucent
Window
Selenium
Iron
Electricity from light

APPENDIX C

NAME: _____

DATE: _____

GRADE: _____

Level I INTRODUCTION TO ELECTRICITY

UNIT 5 SOURCES OF ELECTRICITY

TEST

List five sources of electricity and state how electricity is produced by each source.

1.

2.

3.

4.

5.

The following questions are True and False items, place a T or F to make each statement correct.

6. _____ Electrolyte is formed when suphuric acid and water is mixed.

7. _____ The formula for sulphuric acid and water is H2S04.

8. _____ Magnet can be created by placing a metal into an energized coil of wire.

9. _____ When two unlike poles are placed close together, they repel each other.

10. _____ Electricity is produced when pressure is applied to a crystal

11. _____ Batteries are examples of static electricity

LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNTI 6 Electrical Distribution

Instructor Plan

Student Objectives:

a. State the purpose and location of the nearest power plant in your area.

b. Identify the transmission lines when shown a distribution system lines.

c. Identify and differentiate between the distribution lines and transmission lines.

d. Identify the service conductors on a drawing or an actual installation

e. Distinguish between feeder lines and service lines, and state the function.

a. The power plant

1. Located in Lower Base, Tanapag
   Purpose: To generate enough power to provide the electrical needs of the island.
   TM 1 Note: Voltage output from the generator _____ volts.

b. Transmission Line
1. The power lines that leave the generating plant..usually the highest rated voltage line in the system.
   Note: step-up Substation on TM
   TM 1

c. Distribution Lines
1. Distribution lines are mounted at a lower height than the transmission lines and are of a lower voltage rating than the transmission lines.
   TM1: Note: Step-down Substation before distribtuion lines.

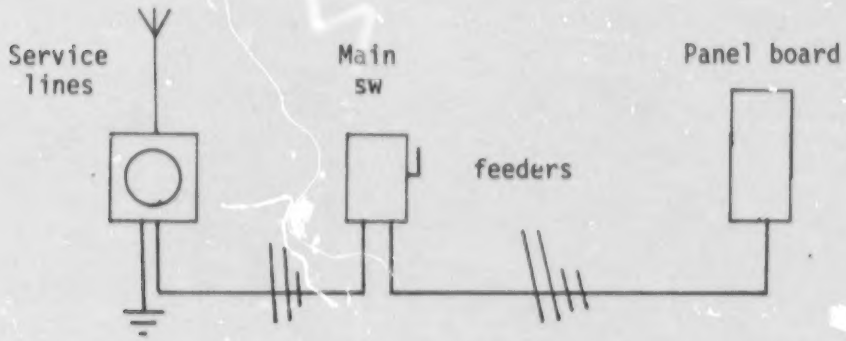
d. Services
   1. Those are the conductors from the last pole to the premises being serviced. Either overhead or underground. TM1

   2. Have students state wether their service is underground or overhead.

e. Feeder Lines
   1. Feeder lines or conductors are those lines from the service equipment to the panelboard.

   2. Residential wiring usually employ four (4) conductors.
      2 hot conductors
      1 neutral conductor
      1 equipment grounding conductor

   3. Diagram of feeder conductors:



f. Arrange for field trip to the power plant

g. Administer exam.

NAME:_____

DATE:_____

GRADE:_____

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 6 ELECTRICAL DISTRIBUTION

TEST

This is a matching test, you are to write the alphabet in the space provided at the end of each statement that best describes the major parts of the electrical distribution system.

1. Provides the necessary energy to supply the island with electricity. ___
2. The conductors from the last pole to the premises. ___
3. Those conductors that includes a neutral and equipment grounding conductors. ___
4. Those conductors that emerge from the power plant and possess the highest voltage in the system. ___
5. Those conductors that feeds the transformers on the power poles. ___

a. Distribution lines

b. Feeder lines

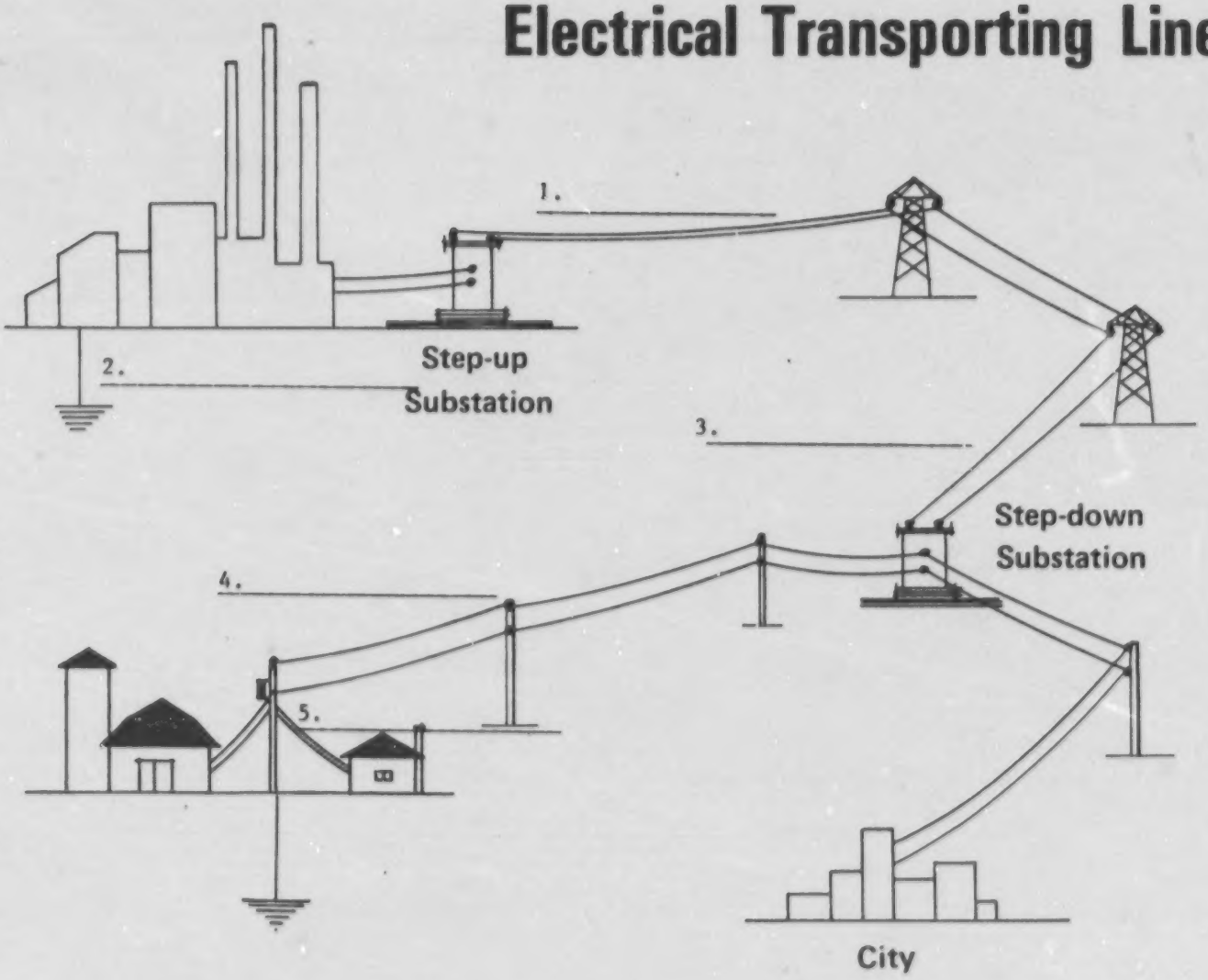
c. Transmission lines

d. Service lines

e. Power plant

On the attached handout, place/write in the terms in the proper locations.

Electrical Transporting Lines



LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 8 Magnetism

Instructor Plan

Student Objectives:

a. State the laws of magnetism
b. State some applications of electromagnetism and how it can be strengthened.
c. Name the basic components of a DC generator and its function

Introduction

History: 200 BC Greeks discovered magnets and called them magnesia. Chinese, about 1100 AD called them leading stone and used by mariners as direction finders. Sometimes called magnetite or lode stones.

Characteristics: Two magnetic poles
Repulsion
Attraction
Direction (north geographical pole)

a. Laws of magnetism
   a.1 Repulsion and attraction
   a.2 Lines of force
   Demonstration: place paper over bar magnet and pour iron fillings to form a pattern. Tap paper slightly.
   a.3 Magnetizing iron
   Align molecules
   Retentivity: Ability to retain magnetism
   a.4 Permeability: Ability to conduct magnetic field
   Magnetism has no known insulation
   Demonstration: experiment with magnet and glass, paper wood.

b. Electromagnetism
   b.1 Condition: When current flows through a conductor, a magnetic field is developed.
   Demonstration: with current flowing through a conductor and a compass or magnet.
   Left hand rule (current flow)

b.2 Strength of magnetic field depends on the following conditions:
Source
Number of turns of wires
Type of iron core and size of core
Demonstration: experiment with pencil and nail to show strength of electromagnets. #1 Science Activities, #4 Science Activities

b.3 Applications of electromagnets
Relays
Coils
Vibrating bells
Solenoids

C. DC Generator

c.1 Definition: A machine designed for generating direct-current. Electricity.

c.2 Three condition necessary for generating electric current.
Magnetic field
Closed circuit
Motion

c.3 Basic concept
When a conductor is moved through a magnetic field, a voltage is induced in the conductor

c.4 Four basic parts of a DC generator
Wire loop
Magnetic field
Commutator
Brushes

Student Project: Conduct experiments 1 or 4. Explain concept of experiments.

NAME: _____
DATE: _____
GRADE: _____

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT H MAGNETISM

TEST

The following 10 questions are multiple choice questions. You are to select the answer or answers which makes the statement correct.

1. The region of influence around a magnet is called _____.
   a. Resistance
   b. Reluctance
   c. Magnetic field
   d. Field of force

2. Some magnets are found in its natural form, these are referred to as _____.
   a. Lime stone
   b. Load stone
   c. Lead stone
   d. Wheat stone

3. Magnets with like poles will _____.
   a. Repel
   b. Attract
   c. Neutralize

4. If allowed to swing freely, a magnet will align itself so that its _____ pole points toward the geographical north pole.
   a. South
   b. North

5. A magnet is a material which is surrounded by a _____.
   a. Electric current
   b. Magnetic field
   c. Conductive field
   d. Inductive field

6. When electric current passes through a wire, a _____ is produced.
   a. Conductive field
   b. Inductive field
   c. Magnetic field
   d. Armature field

7. A basic rule of magnetism is that like poles _____ while unlike poles _____.
   a. Attract and repel
   b. Repel and attract
   c. Attract and attract

Briefly answer the following four questions.

8. Define permeability:

9. List at least four examples where electromagnets are used in electrical installations.

   a.
   b.
   c.
   d.

10. Name the basic components of a DC Generator.

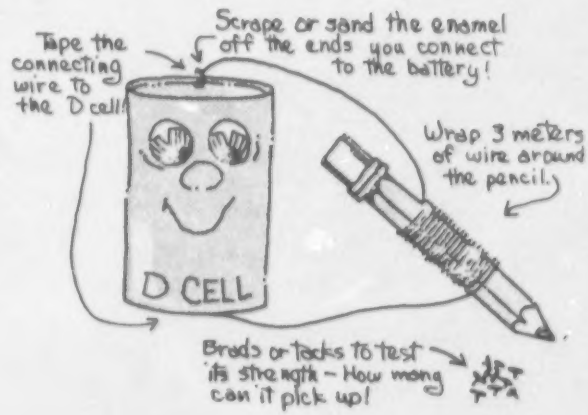
11. Refer to question 10 and describe the function of each component.

HOW MUCH STRONGER IS AN ELECTROMAGNET MADE ON A BOLT THAN ON A PENCIL ?

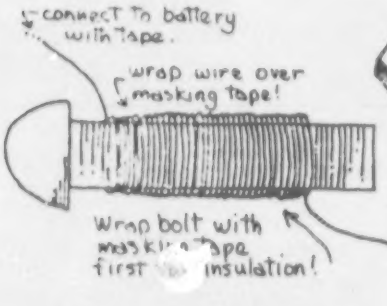
MATERIALS:

6 Meters #24 enameled copper wire, fine sandpaper, 1 D cell, masking tape, brads or tacks, 3" bolt, pencil, compass

Make an electromagnet on the pencil like this:


Tape the connecting wire to the D cell!
Scrape or sand the enamel off the ends you connect to the battery!
Wrap 3 meters of wire around the pencil.
D CELL
Brads or tacks to test its strength - How many can it pick up!

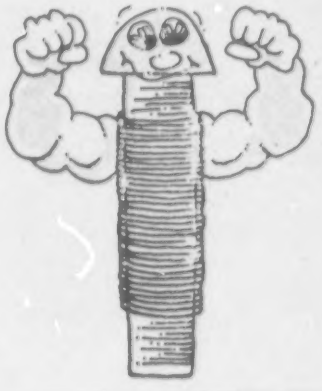
Test its strength with brads or tacks!


connect to battery with tape.
wrap wire over masking tape!
Wrap bolt with masking tape first for insulation!
connect to battery with tape.

Make an electromagnet on the bolt like this. Test it, too!

Try this experiment with a permanent magnet instead of your electromagnet - compare the strength of each!

Can you think of ways to make your electromagnet stronger?



See how far away from a compass you can hold either and get results.

Save your electromagnet for future activities

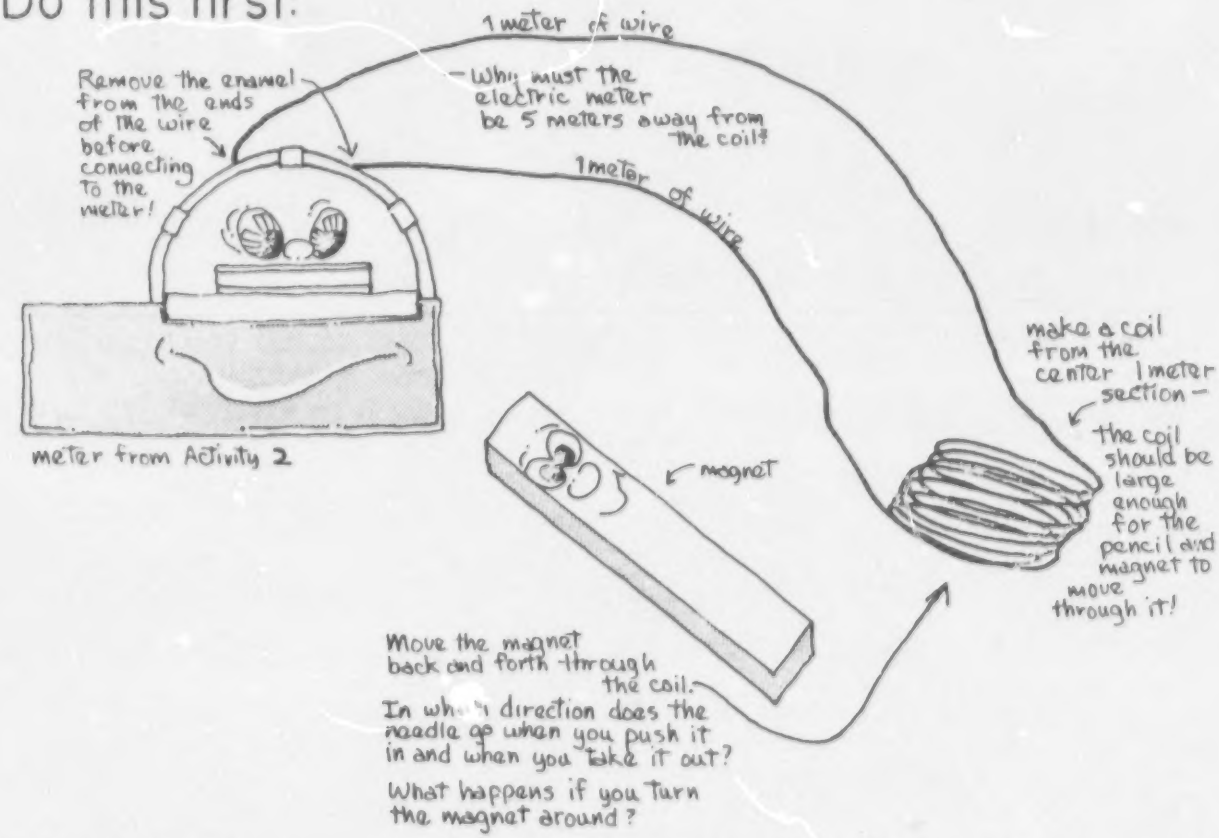
WHAT IS THE MOST ELECTRICITY YOU CAN MAKE USING A MAGNET AND A COIL?

4

MATERIALS:

Electric meter from Activity 2
Small bar magnet, masking tape, fine sandpaper
3 Meters #24 enameled copper wire

Do this first:


1 meter of wire
Remove the enamel from the ends of the wire before connecting to the meter!
Why must the electric meter be 5 meters away from the coil?
1 meter of wire
make a coil from the center 1 meter section
the coil should be large enough for the pencil and magnet to move through it!
meter from Activity 2
magnet
Move the magnet back and forth through the coil.
In which direction does the needle go when you push it in and when you take it out?
What happens if you turn the magnet around?

What happens to the compass needle? Try any way you can think of to make the needle swing. How far can you make it go?

LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 10 Low Voltage Circuit

Instructor Plan

Student Objectives:

- State the uses of low voltage circuits in residential wiring and other applications.
- State the procedure in wiring a signal circuit.
- Name three different types of signal devices used in residential wiring.
- List the equipment and supplies needed for wiring a low voltage signal circuit.

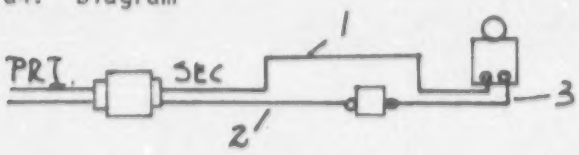
Use of low voltage circuits

a. Used in residential dwellings
b. Used in office buildings
c. Used in industrial plans

Procedures in wiring signal circuits

a. Three rules for wiring signal circuits

a1. Connect a conductor to one side of source to signal device.
a2. Connect a conductor from other side of source to pushbutton or control point.
a3. Connect a conductor from pushbutton to signal device.
a4. Diagram



Operation of signal devices

a. Vibrating bell
b. Buzzer
c. Door chimes

c1. Single-tone
c2. Two-tone
c3. Multi-tone

Signal circuit equipment

a. Transformers

a1. Voltage rating
a2. Volt-ampere rating

b. Wire/conductor
c. Pushbutton

NEC requirement

a. Article 725

Student Application

a. Construct a low voltage circuit

ASSIGNMENT SHEET

NAME: _____
DATE: _____
GRADE: _____

LEVEL I INTRODUCTION TO ELECTRICITY

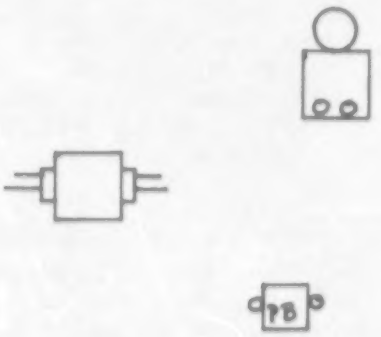
UNIT 10 LOW VOLTAGE CIRCUITS

Objective: Install wiring using low voltage equipment.

PLAN

1. Complete the wiring diagram on the right.
2. Have instructor check diagram. OK____.
3. Complete material list and cost in classroom using materials catalog.
4. Gather materials in shop and complete wiring on board.
5. Have instructor check wiring before energizing circuit. OK_____.
6. Replace all materials from project to it's proper storage.
7. Answer questions listed below.
8. Turn project sheet to instructor for grade.

WIRING DIAGRAM



MATERIALS - LIST THEM DOWN ACCORDING TO CATALOG NAMES

1.	6.	11.
2.	7.	12.
3.	8.	13.
4.	9.	14.
5.	10.	15.

QUESTIONS:

1. What size conductors are normally used in this type of wiring?

2. Does the Code cover Low Voltage Wiring? State your evidence.

3. If the resistance of the chimes is 3 ohms, what would the current be? Work your problem on this sheet.

LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 11 USE AND CARE OF TEST INSTRUMENTS AND EQUIPMENT

Instructor Plan

Student Objectives:

1. State the importance of proper handling and transporting of meters.
2. Describe the reason for zeroing the meter.
3. Demonstrate the use of each scale on a meter.
4. Distinguish between positive terminals and negative terminals either through color code or symbols.
5. Demonstrate the ability to safely and properly measure voltage across a load.

Introduction:

Importance of knowing what to do before selecting and using any test instrument or equipment.
Importance of safety procedure.
Importance of reading manual before operating instrument.

1. Handling and transporting meters

    1.1 Expensive and delicate instrument
    1.2 The heart of an electrician
    1.3 Set selector switch for "off" or "transit" when not in use
    1.4 Demonstrate

2. Zeroing the meter

    2.1 Accuracy: Always zero meter before using
    2.2 Zero meter when changing scale (accuracy)
    2.3 Always observe meter movement
    2.4 Demonstrate zeroing in of meter (Ohm/resistance scale)

4. Scale setting/range selection

    4.1 Predetermine reading and set scale to highest range
    4.2 Before testing, predetermine where pointer should point
    4.3 Observe meter movement
    4.4 Demonstrate range selection on live circuit

5. Identifying polarity

    5.1 Observe polarity when measuring DC sources

5.2 Red leads for positive and black leads for negative
5.3 Always double check colors of test leads
5.4 Demonstrate with DC batteries

6. Measuring voltage

6.1 Always select highest voltage range when beginning test
6.2 Observe meter movement
6.3 Select range which gives the most accurate reading
6.4 Always measure across the load (parallel)
6.5 Demonstrate with DC batteries

7. Measuring current

7.1 Always have meter in series with the load
7.2 Observe meter movement
7.3 Select highest range first
7.4 Demonstrate with amprobe on lite circuit in shop

8. Measuring resistance

8.1 Always zero meter first before testing
8.2 Observe meter movement
8.3 Always check for voltage first before measuring resistance
8.4 Always turn meter to off position or transit when not in use
8.5 Demonstrate with resistors

9. Proper storing

9.1 Always turn meter off or on transit before storing
9.2 Meter face should be facing up
9.3 Storage area should be cool and dry (humidify air if possible)
9.4 Do not place anything on meters
9.5 Demonstrate

Have students read manuals and practice taking measurements.

LESSON PLAN

LEVEL I INTRODUCTION TO ELELCTRICITY

UNIT 12 ELECTRICAL SYMBOLS

Instructor Plan:

Student Objectives:

Identify and draw the following symbols:

1. Introduction:
   Used as an international language by electrical workers
   Faster to draw symbols than actual objects
   Electricians should know as many symbols as possible

   a. Single pole switch

      Draw symbol of a single pole switch on chalkboard
      Show actual switch to students
      Have students draw symbols in notebook. Stress neatness

   b. Double pole switch

      Draw a symbol of a double pole switch on chalkboard
      Show actual switch to students
      Have students draw symbols in notebook

   c. Three-way switch

      Draw a symbol of a three-way switch on chalkboard
      Show actual switch to students
      Have students draw symbol in notebook

   d. Four-way switch

      Draw a symbol of a four-way switch on chalkboard
      Show actual switch to students
      Have students draw symbols in notebook

   e. Duplex receptacle

      Draw a symbol of a duplex receptacle on chalkboard
      Show actual receptacle to students
      Have students draw symbols in notebook

   f. Special purpose receptacle

      Draw symbol for a special purpose receptacle on chalkboard

Show dryer or range receptacle to students
Have students draw symbol in notebook

g. Split circuit receptacle

Draw a symbol of a split circuit receptacle on chalkboard
Show actual split circuit receptacle to students
Have students draw symbol in notebook

h. Clock outlet

Draw a symbol of a clock outlet on chalkboard
Show actual clock outlet to students
Have students draw clock outlet in notebook

i. Floor outlet

Draw a symbol of a floor outlet on chalkboard
Show actual floor outlet to students
Have students draw floor outlet in notebook.

j. Lighting outlet

Draw a symbol of a lighting outlet on chalkboard
Show actual lighting outlet to students
Have students draw lighting outlet in notebook

k. Lighting panel

Draw a symbol of a lighting panel on chalkboard
Show actual lighting panel to students
Have students draw symbol in notebook

l. Low voltage pushbutton

Draw a symbol of a low voltage pushbutton on chalkboard
Show actual pushbutton to students
Have students draw symbol in notebook

m. Lampholder

Draw a symbol of a lampholder on chalkboard
Show actual lampholder to students
Have students draw symbol in notebook

n. Weatherproof receptacle

Draw a symbol of a weatherproof receptacle on chalkboard
Show students actual weatherproof receptacle
Have students draw symbol in notebook

o. Fan outlet

Draw a symbol of a fan outlet on chalkboard
Show students actual fan outlet
Have students draw symbol in notebook

p. Junction box

Draw a symbol of a junction box on chalkboard
Show actual junction boxes to students
Have students draw symbol in notebook

q. Bell or Buzzer

Draw a symbol of a bell and buzzer on chalkboard
Show actual bell and buzzer to students
Have students draw symbols in notebook

r. Transformer LV

Draw a symbol of a transformer on chalkboard
Show actual transformer to students
Have students draw symbol in notebook

Review and summarize lesson with students

Administer examination

NAME:_____

DATE:_____

GRADE:_____

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 12 ELECTRICAL SYMBOLS

TEST

Draw the electrical symbols for the following items:

1. Floor outlet _____
2. Four-way switch _____
3. Lighting panel _____
4. Weatherproof receptacle _____
5. Special purpose outlet _____
6. Lampholder _____
7. Clock outlet _____
8. Junction box _____
9. Single pole switch _____
10. Three-way switch _____
11. Duplex receptacle _____
12. Lighting outlet _____
13. Low voltage pushbutton _____
14. Double pole switch _____
15. Split circuit receptacle _____

LESSON PLAN

LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

UNIT 4 INTRODUCTION TO THE NATIONAL ELECTRICAL CODE AND STANDARDS

Instructor Plan

Student Objectives:

a. State the purpose of the NEC.
b. Identify those areas that are covered and those that are not covered by the NEC.
c. Explain how the code is arranged and state specific articles used in general wiring practices.
d. Define terms used in the NEC which pertain to residential wiring.
e. State the difference between mandatory and recommended rules and its application.
f. State procedure for filing for a formal code interpretation.

Introduction:

Minimum standard for electrical work
Providing a system which is essentially free from hazards
Accepted standards by most authorities having jurisdiction
Standard when taking a journeyman's license
Most widely used standard

1. Purpose: Art. 90-1

    1.1 Practical safe guarding of persons
    1.2 Building and content
    1.3 Provide a system that is free from shorts and grounds

2. Scope: Art. 90-2

    2.1 Coverage of the CODE

        a. Electric conductors
        b. Equipment within public buildings
        c. Industrial substations
        d. Carnivals and yards
        e. Dwellings, apartments, hotels, etc.

    2.2 Not covered

        a. Ships
        b. Watercrafts

c. Railways
d. Mines

3. Code arrangement: Art. 90-3

3.1 Individual chapters (9)
3.2 Chapters 1,2,3, and 4 general requirements
3.3 Chapters 5,6,7 apply to special occupancies
3.4 Chapter 8 deals with communications
3.5 Chapter 9 deals with Tables

4. Definitions. Art. 100

4.1 Define terms used more than once in Code
4.2 Electrical installation dictionary

5. Fundamental rules: Art. 110

5.1 "1" in the beginning of each article covers the fundamental rule for that article
5.2 Mandatory statement uses the word "shall"
5.3 Recommended practice uses the word "should"

6. Interpretation: Art. 90-5

6.1 Procedure for formal interpretation
6.2 May be necessary when there is a dispute in local interpretation

7. Enforcement: 90-4

7.1 Local government

8. Examination of equipment for safety: Art. 90-6

8.1 Purpose to safe guard against defective equipment
8.2 Examination done be testing labs such as UL or other private testing labs.

9. Wiring planning: Art. 90-7

9.1 Reasons for adequate wiring
9.2 Ample size raceways being provided
9.3 Allowance for future increase in the use of electricity

10. Revision of the NEC:

10.1 Purpose for revision
10.2 Technological changes

10.3 New research and findings
10.4 Changes made every three years

11. History of the NEC

11.1 Student assignment and report
11.2 NEC originally drawn in 1897 by insurance, electrical, architectural, and allied interests.
11.3 Original CODE prepared by the National Conference of Standard Electrical Rules.
11.4 1911 the National Conference was disbanded and the National Fire Protection Association (NFPA) sponsored the NEC.
11.5 Page xi NATIONAL ELECTRICAL CODE HANDBOOK Sixteenth Edition.

APPENDIX D SAMPLE ATTENDANCE AND PROGRESS CHARTS

SAMPLE ATTENDANCE AND PROGRESS SHEETS

Recording Student Progress

A major principle of vocational education is that the students learn skills or the performance of operations of a trade with the production job vehicle to accomplish this objective.

The operations are defined on the shop progress record and it is imperative that the instructor have some means of recording the student experiences and achievement.

The approved method of recording student progress is as follows:

INSTRUCTED - This designation on the progress record indicates that the student has performed a skill with the assistance of and under the supervision of the instructor.

PRACTICED - This designation on the progress records indicates that the student has performed a skill either alone or with little help from the instructor.

PROFICIENT - This designation on the progress record indicates that the student is capable of performing a skill alone within a reasonable amount of time with no assistance from the instructor. In effect this implies that the student has been tested for that skill.

This method of noting student progress will define accurately student achievement and in fact will point out any weaknesses the student may have in certain operations; thus highlighting areas where the student may need help.

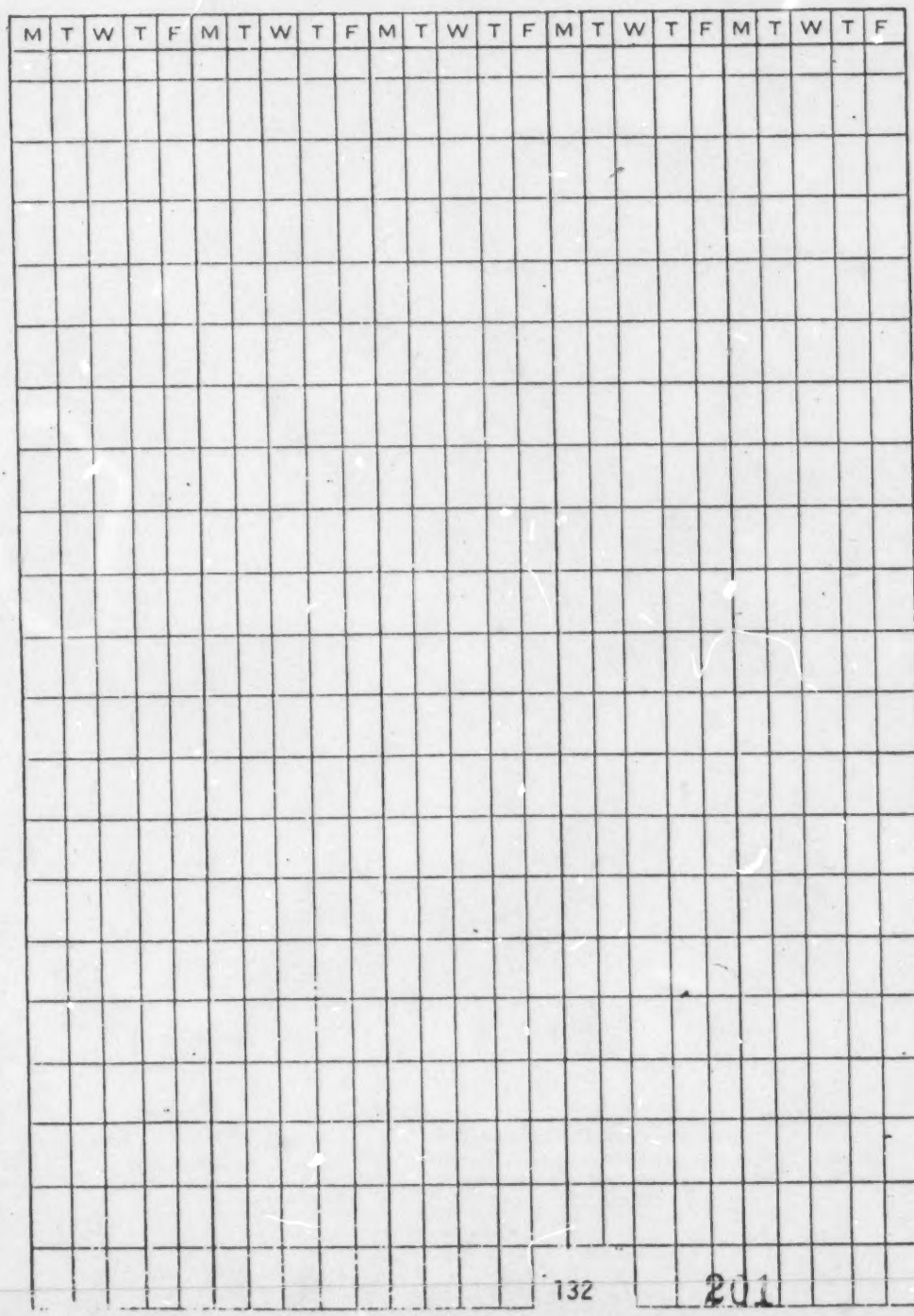
Grades should be kept on student daily progress cards or in roll books.

NOTES . . . .

Grade ..... Year ..... Instructor .....

STUDENT	TOOL CHECK NO	LOCKER NO	TEXT BOOK NO	SHOP GRADES MARKING PERIOD						THEORY GRADES MARKING PERIOD					
				1	2	3	4		F	1	2	3	4		F

ATTENDANCE: MONTH YEAR



PROGRESS RECORD INDEX

LEVEL I

CAREER ORIENTATION
SHOP ORIENTATION
SAFETY
USE AND CARE OF ELECTRICAL WIRING TOOLS
SOURCES OF ELECTRICITY
ELECTRICAL DISTRIBUTION
BASIC ELECTRICITY DC
MAGNETISM
ELECTRICAL DIAGRAMS
LOW VOLTAGE CIRCUITS
USE AND CARE OF TEST INSTRUMENTS AND EQUIPMENT
IDENTIFYING ELECTRICAL SYMBOLS
ELECTRICAL CONDUCTORS AND INSULATORS
ELECTRICAL TERMINATIONS
ELECTRICAL WIRING DEVICES AND MATERIALS
GUEST SPEAKERS
FIELD TRIPS

LEVEL II

SHOP ORIENTATION
SAFETY
BASIC ELECTRICAL THEORY AC
INTRODUCTION TO THE NEC AND STANDARDS
ELECTRICAL BLUEPRINT READING
ELECTRICAL TERMINATIONS
ELECTRICAL DIAGRAMS
ELECTRICAL WIRING DEVICES AND MATERIALS
OVERCURRENT PROTECTION
WIRING METHODS
GROUNDING
ELECTRICAL SERVICE SYSTEMS
TROUBLESHOOTING PROCEDURES
GUEST SPEAKERS
FIELD TRIPS

LEVEL III

SAFETY
PLANNING AND LAYING OUT ELECTRICAL CIRCUITS
ELECTRICAL SYSTEM ANALYSIS
ADVANCED INTERPRETATION OF THE NATIONAL ELECTRICAL CODE
WIRING A RESIDENTIAL UNIT/DWELLING
LIGHTING FIXTURES
RENOVATION AND TROUBLESHOOTING
JOB ACQUISITION SKILLS
ADVANCED ELECTRICAL WIRING
GUEST SPEAKERS
FIELD TRIPS

PROGRESS CHART

INTRODUCTION TO ELECTRICITY

LEVEL I

NAME

	UNIT 1	a. Job des.	b. Entry level requirement	c. Job ethics	d. Working condition	e. Job opportunity	UNIT 2	a. Shop policy	b. Intro to course content	c. Grading policy	d. Books and references	e. Shop layout	f. Location of tools	UNIT 3	a. Safety program	b. First aid	c. Ventilation and lighting	d. Material handl. storage	e. Location of fire extinguishers	UNIT 4	a. screw driver	b. Phillips screw driver	c. Knife	d. Diagonal pliers	e. Longnose pliers	f. Side cutters lineman's pliers	g. Channel lok pliers	h. Torpedo level	i. Tape rule	j. Folding rule	k. Chisels	l. Hammer	m. Keyhole saw	n. Wire stripper	o. Hack saw	p. Vise-grip pliers	q. Tool pouch	r. Fish tape	s. Portable elec. drill	
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PROGRESS CHART

INTRODUCTION TO ELECTRICITY

LEVEL I

NAME	UNIT 5	1 a. Friction	b. Chemical	c. Magnetic	d. Pressure	e. Light	f. Heat	g. Electricity	UNIT 6	a. Power plant	b. Transmission lines	c. Distribution lines	d. Services	e. Feeder lines	UNIT 7	a. Electron theory	b. Atomic theory	c. Batteries	d. Conductivity of materials	e. Ohm's Law	f. Series circuit	g. Parallel circuit	h. Combination circuit	i. Watts	UNIT 8	a. Laws of Mag.	b. Electro-magnetism	c. DC Generator	UNIT 9	a. Schmetic dia.	b. Wiring diagram	UNIT 10	a. Use of L.V.	b. Procedure in wiring L.V.	c. Operation of sig. devices	d. Signal circuit equipment	UNIT 11	a. Handling and tr	b. Zeroing the meter	c. Scale setting	d. Identifying polarity	e. measuring voltag
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PROGRESS CHART

INTRODUCTION TO ELECTRICITY

LEVEL I

NAME	1 f. Measuring current	2 g. Measuring resistance	3 h. Storing	UNIT 12 4 a. Single pole sw	5 b. Double pole sw	6 c. Three-way switch	7 d. Four-way switch	8 e. Duplex receptacle	9 f. Special purpose receptacle	10 g. Split circuit receptacle	11 h. Clock outlet	12 i. Floor outlet	13 j. Lighting outlet	14 k. Lighting panel	15 l. L.v. pushbutton	16 m. Lampholder	17 n. Weatherproof receptacle	18 o. Fan outlet	19 p. Junction box	20 q. Bell or buzzer	21 r. Transformer	UNIT 13 22 a. Imp. cond/ins.	23 b. Conductor resistance	24 c. Conductor materials	25 d. Length of conductors	26 e. Sizing	27 f. Ampacity	28 g. Use of tables and charts	UNIT 14 29 a. Pigtail splice	30 b. Use splice	31 c. Western union splice	32 d. Terminal screw connection	33 e. Solderless connections	34 f. Reinsulating splices	UNIT 15 35 a. Classification	36
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PROGRESS CHART

INTRODUCTION TO ELECTRICITY

LEVEL I

NAME

	1 b. Switches	2 c. Receptacles	3 d. Lampholders	4 e. Junction boxes	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
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PROGRESS CHART

ELECTRICAL PRINCIPLES AND PRACTICES

LEVEL.II

NAME

	UNIT 1	a. Shop policy	b. Intro to course content	c. Grading policy	d. Books and references	e. Shop layout	f. Location of tools	UNIT 2	a. Safety program	b. First aid	c. Ventilation and lighting	d. Material hand. and storage	e. Location of fire extinguishers	UNIT 3	a. Uses of AC curr.	b. Cycle	c. Frequency	d. Phase	e. Voltage	f. Transformers	g. Inductance	h. Capacitance	UNIT 4	a. Purpose of NEC	b. Scope	c. Code arrangement	d. Definition	e. Fundamental rules	f. Interpretation	g. Enforcement	h. Exam of equip. for safety	i. Wiring planning	j. Revision of the NEC	k. History of the NEC	UNIT 5	a. Intro to blueprt	b. Material des. ription	c. Scales	d. types of drawings	e. Calculation		
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PROGRESS CHART

ELECTRICAL PRINCIPLES AND PRACTICES

LEVEL II

NAME

	UNIT 6	1 a. Types of splices	b. Reinsulating	2 c. Soldering irons and guns	3 d. Use of crimping tools	4 e. Prep conductors for termination	5 f. Use of terminal clips	6 g. Use of wire nuts	7 h. Use of split-bolt connectors	8 UNIT 7	9 a. Use of diagrams	b. Symbols	10 c. Single pole switch	11 d. Three-way switching	12 e. Four-way switching	13 f. Lighting circuit	14 g. Combo switch and pilot lite	15 UNIT 8	16 a. Definition	b. Switches	17 c. Receptacles	18 d. Lampholders	19 e. Junction boxes	20 f. Panelboards	21 g. Conductors	22 h. Cables	23 i. Raceways	24 j. Cords	25 k. Attachment caps	26 l. Fasteners	27 UNIT 9	28 a. Purpose	b. Types of over-current protect	29 c. Selection	30 d. Usage	31 UNIT 10	32 a. Raceways	b. Cables	33 c. Select. &appli. wiring method	34	35	36
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PROGRESS CHART

ELECTRICAL PRINCIPLES AND PRACTICES

LEVEL II

NAME

	UNIT 11	a. Purpose	b. Types of grounding	c. Methods of grounding	d. Bonding	e. Selecting grd. & bonding cond.	f. NEC requirements	UNIT 12	a. types of service	b. Parts of the service	c. Calculating service	d. Selecting ser. entrance mat.	e. Installing services	f. NEC requirement	UNIT 13	a. Analz elec. sys	b. Determine malfunction	c. Restoring problem	d. Retest	FIELD TRIP																							
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APPENDIX D

PROGRESS CHART

NAME

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APPENDIX E HANDOUTS

HANDOUT 1

Electrical Symbols Commonly Used on Blueprints

GENERAL OUTLETS

Ceiling Wall

- Outlet.
- Blanked Outlet.
- Drop Cord.
- Electrical Outlet; for use only when circle used alone might be confused with columns, plumbing symbols, etc.
- Fan Outlet.
- Junction Box.
- Lamp Holder.
- Lamp Holder with Pull Switch.
- Pull Switch.
- Outlet for Vapor Discharge Lamp.
- Exit Light Outlet.
- Clock Outlet. (Specify Voltage.)

CONVENIENCE OUTLETS

- Duplex Convenience Outlet.
- Convenience Outlet other than Duplex. 1=Single, 3=Triplex, etc.
- Weatherproof Convenience Outlet.
- Range Outlet.
- Switch and Convenience Outlet.
- Radio and Convenience Outlet.
- Special Purpose Outlet. (Des. in Spec.)
- Floor Outlet.

SWITCH OUTLETS

- S — Single Pole Switch.
- S_2 — Double Pole Switch.
- S_3 — Three-Way Switch.
- S_4 — Four-Way Switch.
- S_D — Automatic Door Switch.
- S_E — Electrolier Switch.
- S_K — Key Operated Switch.
- S_P — Switch and Pilot Lamp.
- S_{CB} — Circuit Breaker.
- S_{WCB} — Weatherproof Circuit Breaker.
- S_{MC} — Momentary Contact Switch.
- S_{RC} — Remote Control Switch.
- S_{WP} — Weatherproof Switch.
- S_F — Fused Switch.
- S_{WF} — Weatherproof Fused Switch.

SPECIAL OUTLETS

$O_{a,b,c,etc}$
$O_{a,b,c,etc}$
$S_{a,b,c,etc}$

Any Standard Symbol as given above with the addition of a lower case subscript letter may be used to designate some special variation of Standard Equipment of particular interest in a specific set of Architectural Plans.

When used, they must be listed in the Key of Symbols on each drawing and if necessary further described in the specifications.

Courtesy of American Standards Association of New York, N.Y.

PANELS, CIRCUITS, AND MISCELLANEOUS

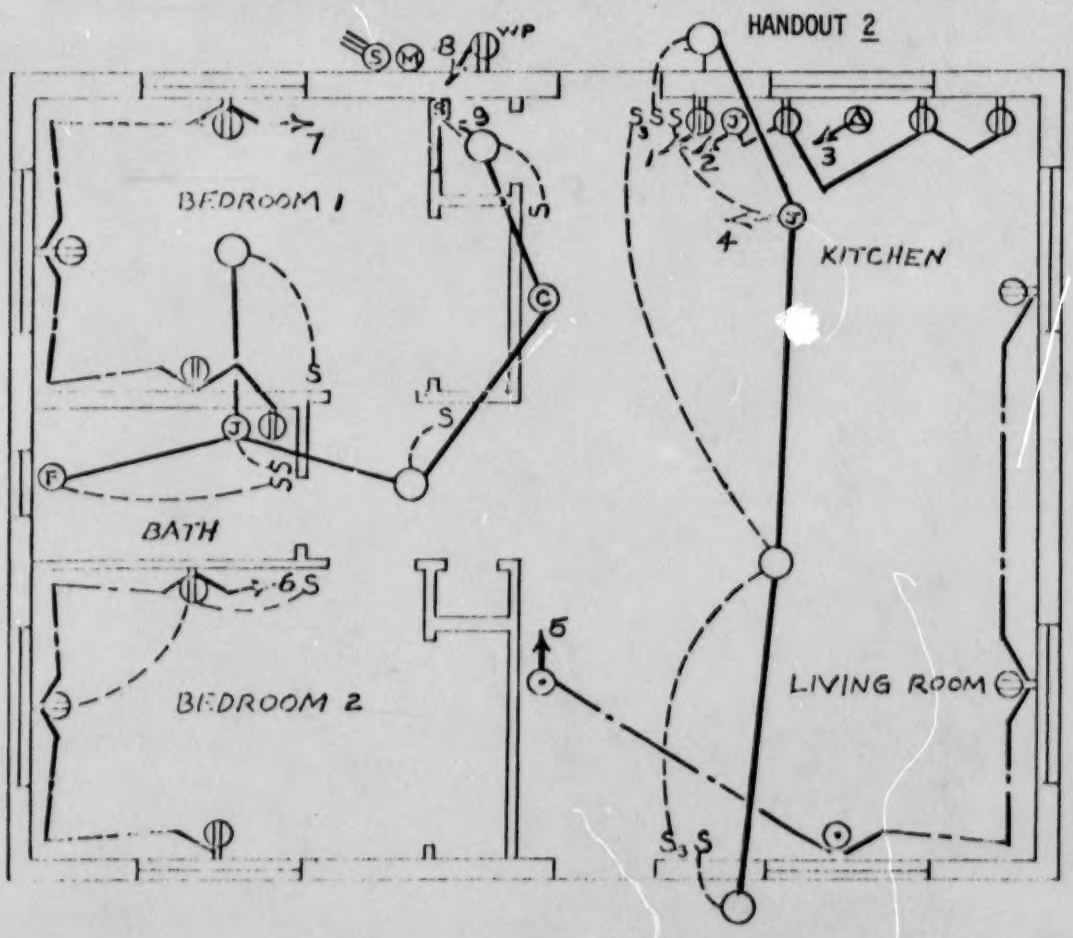
- Lighting Panel.
- Power Panel.
- —— Branch Circuit; Concealed in Ceiling or Wall.
- – – – Branch Circuit; Concealed in Floor.
- ----- Branch Circuit; Exposed.
- Home Run to Panel Board. Indicate number of Circuits by number of arrows.
  Note: Any circuit without further designation indicates a two-wire circuit. For a greater number of wires indicate as follows -#- (3 wires) -##- (4 wires), etc:
- Feeders. Note: Use heavy lines and designate by number corresponding to listing in Feeder Schedule.
- Underfloor Duct and Junction Box. Triple System. For double or single systems, eliminate 1 or 2 lines. This symbol equally adaptable to auxiliary system layouts.
- (G) Generator.
- (M) Motor.
- (I) Instrument.
- (T) Power Transformer. (Or draw to scale.)
- Controller.
- Isolating Switch.

AUXILIARY SYSTEMS

- Push Button.
- Buzzer.
- Bell.
- Annunciator.
- Outside Telephone.
- Interconnecting Telephone.
- Telephone Switchboard.
- (T) Bell Ringing Transformer.
- [D] Electric Door Opener.
- [FB] Fire Alarm Bell.
- [F] Fire Alarm Station.
- [C] City Fire Alarm Station.
- [FA] Fire Alarm Central Station.
- [FS] Automatic Fire Alarm Device.
- [W] Watchman's Station.
- [WC] Watchman's Central Station.
- [H] Horn.
- [N] Nurse's Signal Plug.
- [M] Maid's Signal Plug.
- [R] Radio Outlet.
- [SC] Signal Central Station.
- [ ] Interconnection Box.
- Battery.
- ---·---·--- Auxiliary System Circuits.
  Note: Any line without further designation indicates a 2-Wire System. For a greater number of wires designate with numerals in manner similar to ---·---12-No. 18W-¾" C., or designate by number corresponding to listing in Schedule.
- [a,b,c] Special Auxiliary Outlets. Subscript letters refer to notes on plans or detailed description in specs.

ELECTRICAL | ELECTRICAL PLAN

HANDOUT 2



(M)	METER	-----	BRANCH CIRCUIT CONCEALED IN CEILING
○	LIGHTING OUTLET	- - - -	CONTROLS OUTLET
(C)	CLOCK OUTLET	- - -	BRANCH CIRCUIT CONCEALED IN FLOOR
(J)	JUNCTION BOX	S	SINGLE-POLE SWITCH
(A)	SPECIAL OUTLET	S_3	THREE-WAY SWITCH
⊖	DUPLEX OUTLET	▭	FLOURESCENT FIXTURE
$\ominus_{WP}$	WATERPROOF OUTLET	(S)	SERVICE DROP
$\ominus_R$	RANGE OUTLET	→	HOME RUN TO PANEL
⊙	FLOOR OUTLET	[S]	SAFETY SWITCH
(F)	FAN OUTLET	▮	DISTRIBUTION PANEL

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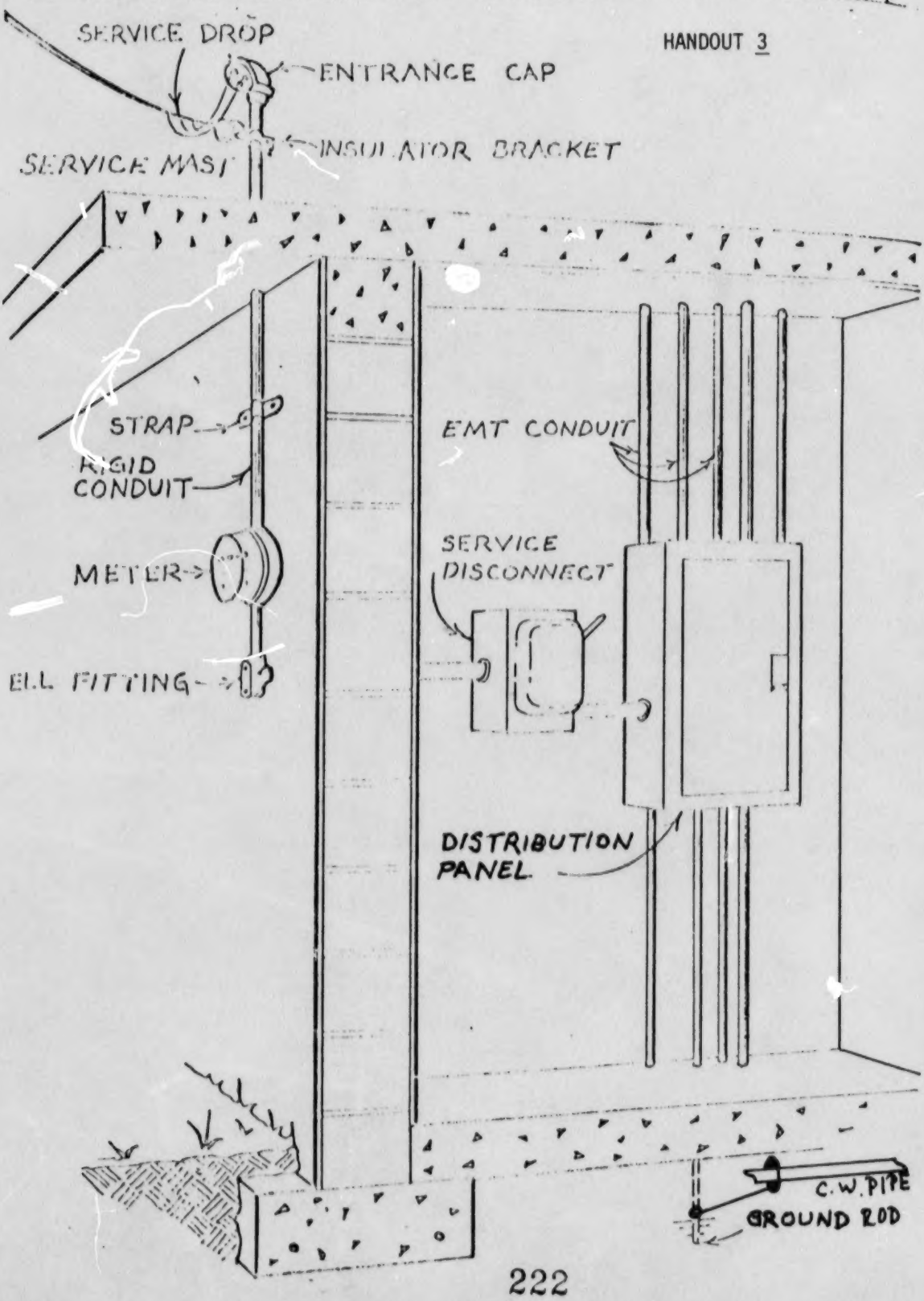
ELECTRICAL | PRINCIPAL PARTS WIRING SYSTEM

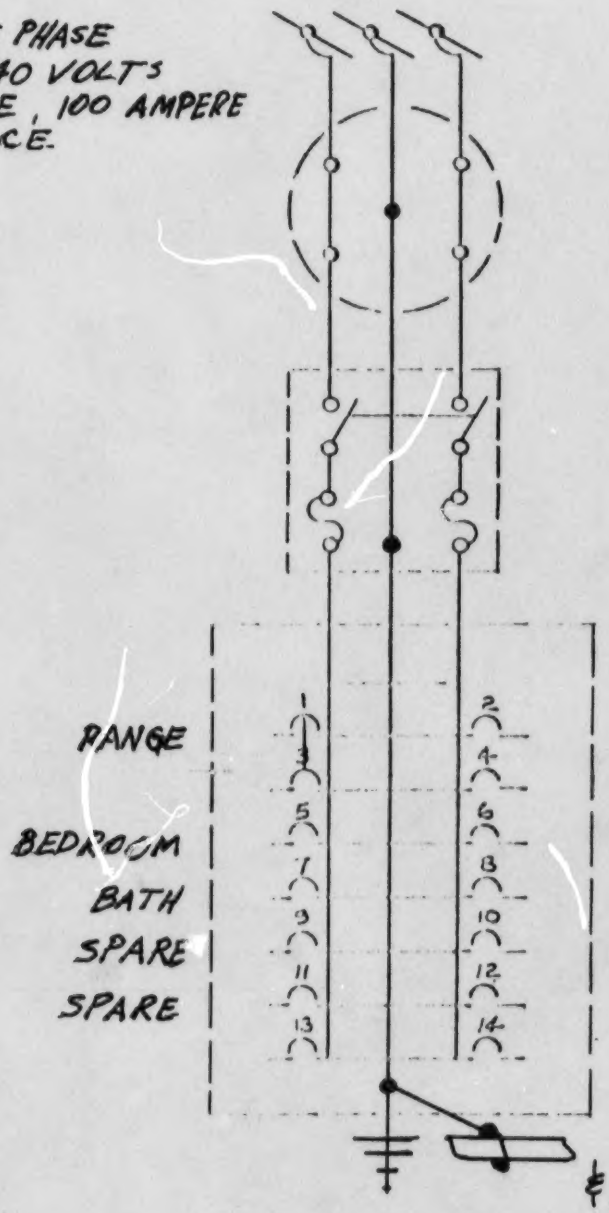
HANDOUT 3



ELECTRICAL | RISER DIAGRAM

HANDOUT 4

SINGLE PHASE
120/240 VOLTS
3 WIRE, 100 AMPERE
SERVICE.



SERVICE DROP

METER

SERVICE DISCONNECT

DISTRIBUTION PANELBOARD

GROUND ROD & C.W. PIPE

CIRCUIT BREAKER

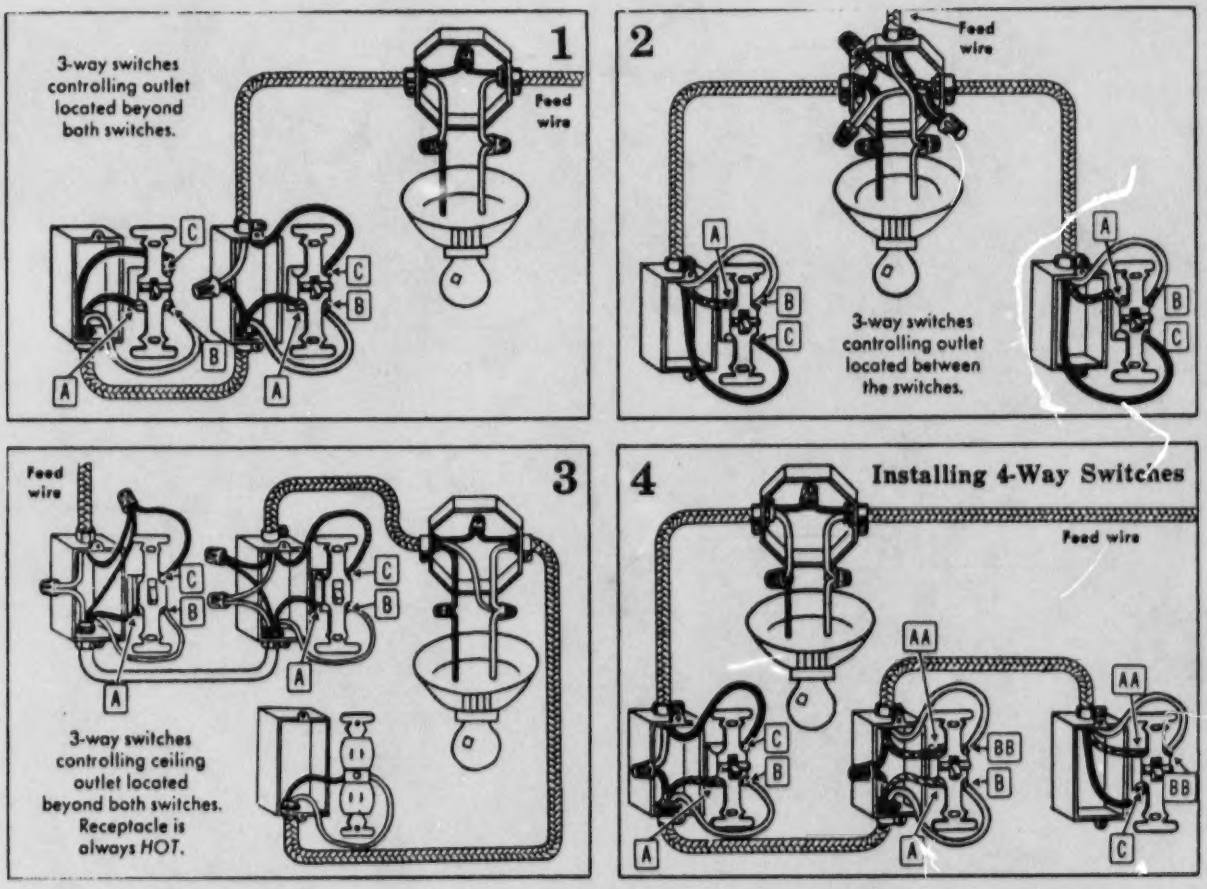
FUSE

GROUND

SWITCH

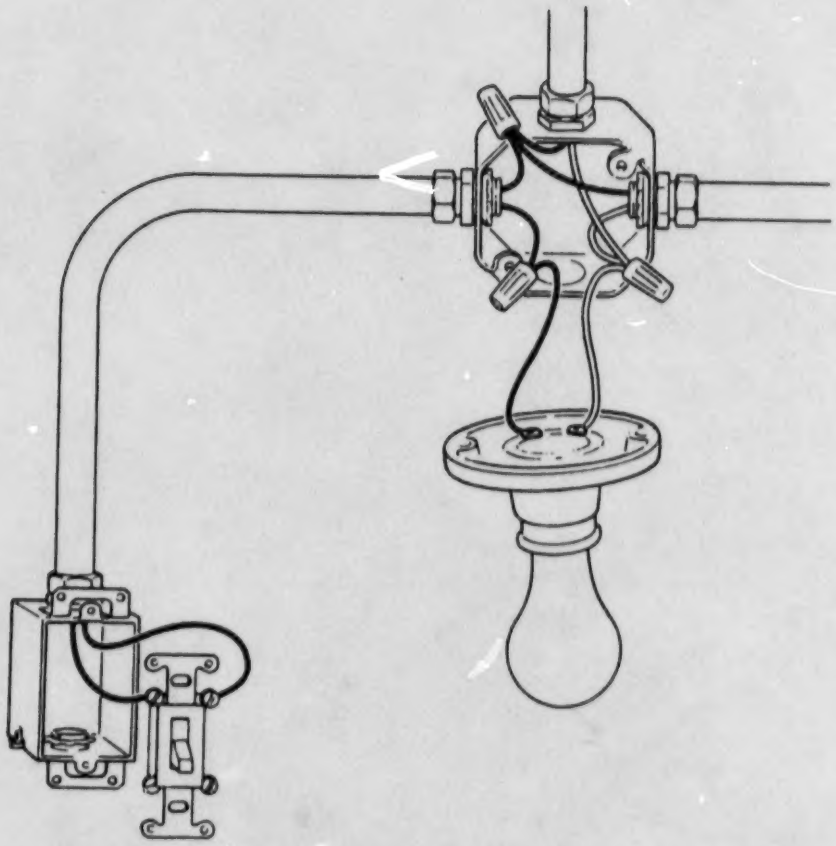
CIRCUIT BREAKER 2 POLE

HANDOUT 5



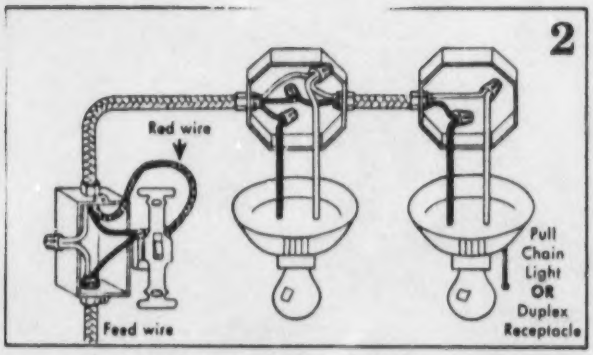
NOTE: This is a wiring method utilizing cables. On three wire cables, the red conductor is designated by black tracers.

HANDOUT 6

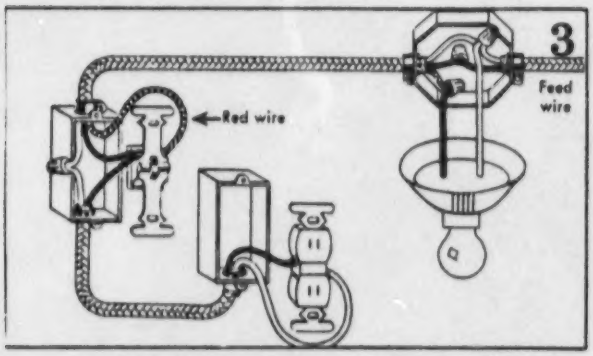


NOTE: A single pole switch controlling a light with source at lighting outlet. In raceway wiring, all conductors to switches are colored. White conductors are not allowed to be connected to switches.

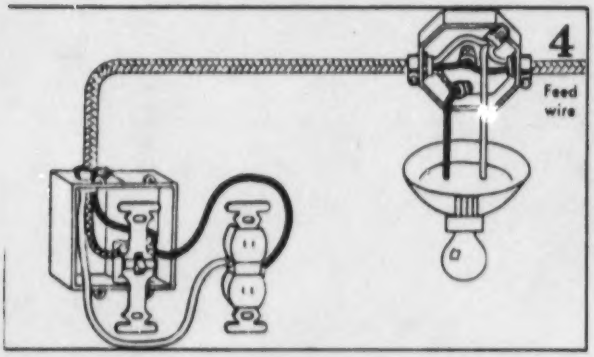
HANDOUT 7



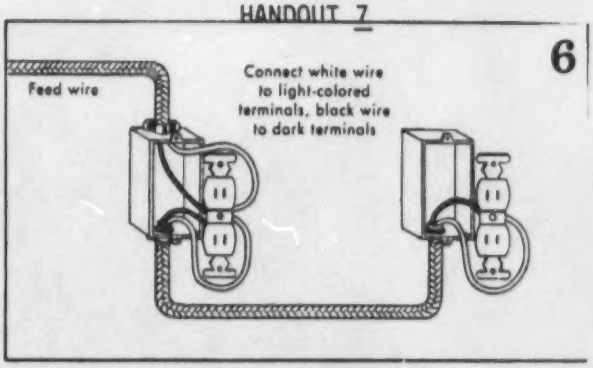
To install two ceiling lights on same line; one controlled by switch



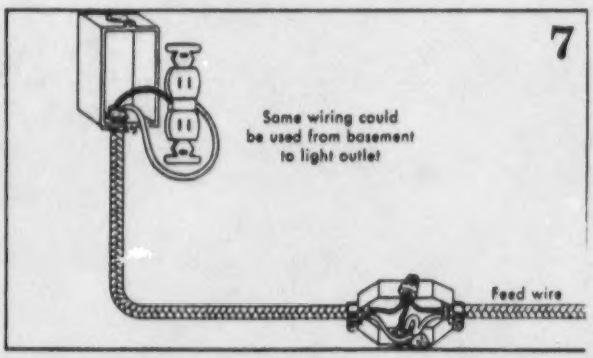
To add a switch and convenience outlet beyond existing ceiling light



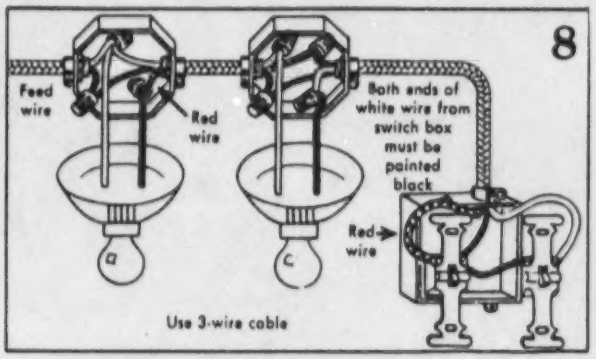
To add a switch and convenience outlet in one outlet box beyond existing ceiling light



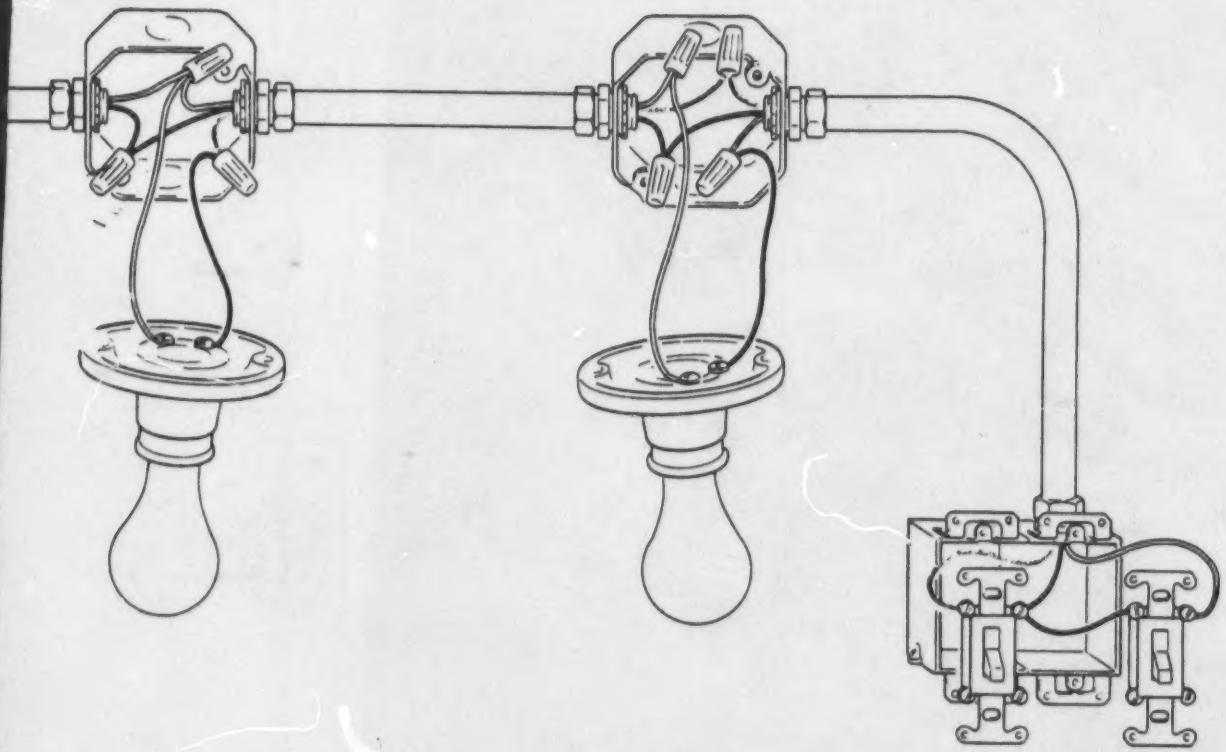
To add new convenience outlets beyond old convenience outlets



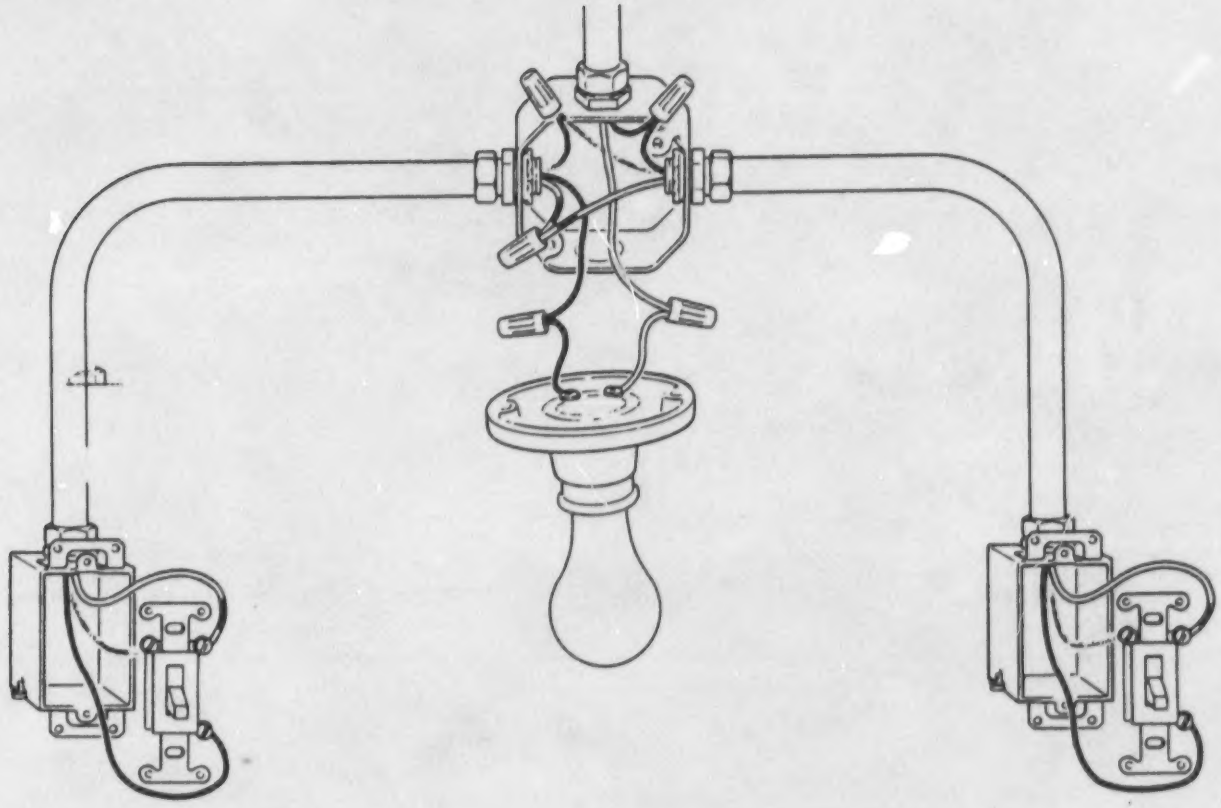
To add a new convenience outlet from an existing junction box



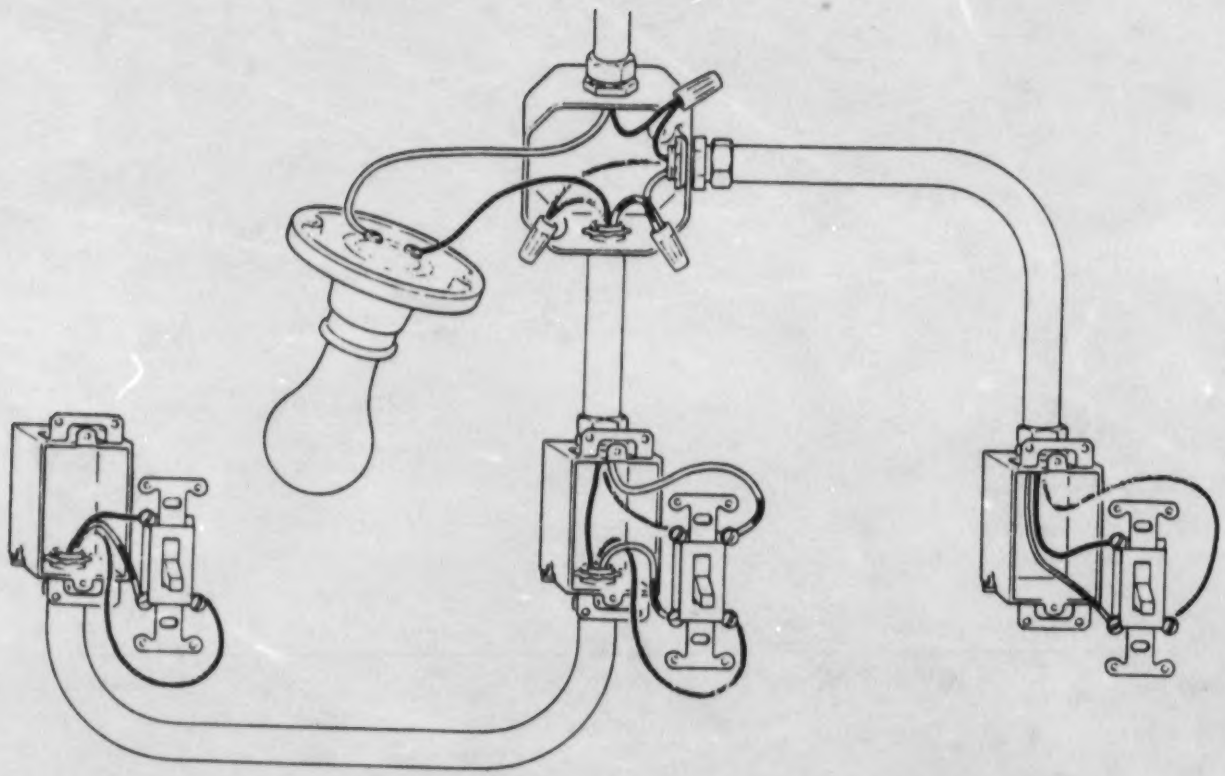
To install one new ceiling outlet and two new switch outlets from existing ceiling outlet



Two ceiling lights controlled by individual switches. (2 gang switch)



Two three-way switches controlling one light. (raceway wiring)



One four-way and two three-way switches controlling one light. (raceway wiring)

HANDOUT 11

KIND OF FIRE DECIDE THE CLASS OF FIRE YOU ARE FIGHTING...	APPROVED TYPE OF EXTINGUISHER MATCH UP PROPER EXTINGUISHER WITH CLASS OF FIRE SHOWN AT LEFT Important! Using the wrong type extinguisher for the class of fire may be dangerous. ...THEN CHECK THE COLUMNS TO THE RIGHT OF THAT CLASS						
	FOAM Solution of Aluminum Sulphate and Bicarbonate of Soda	**CARBON DIOXIDE** Carbon Dioxide Gas Under Pressure	**SODA ACID** Bicarbonate of Soda Solution and Sulphuric Acid	**PUMP TANK** Plain Water	**GAS CARTRIDGE** Water Expelled by Carbon Dioxide Gas	**MULTI-PURPOSE DRY CHEMICAL**	**ORDINARY DRY CHEMICAL**
CLASS A FIRES Use These Extinguishers ORDINARY COMBUSTIBLES • Wood • Paper • Cloth, Etc.							
CLASS B FIRES Use These Extinguishers FLAMMABLE LIQUIDS, GREASE • Gasoline • Paints • Oils, Etc.							
CLASS C FIRES Use These Extinguishers ELECTRICAL EQUIPMENT • Motors • Switches, Etc.							

SAFE SHOP PRACTICES HANDOUT 12

1. Keep hands off all equipment unless assigned to work with.
2. De-energize all circuits before making repairs.
3. Use lockout switches and danger signs when working on circuits.
4. Cut only one electrical wire at a time. Neutral, then ground last.
5. Test all circuits before working on them.
6. Use fuse pullers for removing and replacing cartridge fuses.
7. Fuse all circuits according to code requirements.
8. Repair all circuit defects before replacing fuses.
9. Never leave untaped wires in junction boxes.
10. Set all ladders properly before climbing them.
11. Use proper length ladder for each job. Top on ladder above knees.
12. Never leave tools on ladders.
13. Keep hands off all moving equipment such as belts and pulleys.
14. Leave hot soldering irons on proper rack for cooling.
15. Use tools for jobs they are designed for.
16. Wear goggles for all jobs that create eye hazards.
17. Ground all protable electric equipment.
18. Use proper materials for each job installation.
19. Abide by the National Electrical Code regulations for all electrical work.

FOLLOW ALL SAFETY RULES AND REGULATIONS...

SAMPLE RESUME HANDOUT 17

LEVEL III UNIT 8 JOB ACQUISITION SKILLS

NAME:

ADDRESS:

TELEPHONE:

PERSONAL:

Date of Birth:

Place of Birth:

Height:
Weight:
Marital Status:
Health:

OCCUPATIONAL OBJECTIVE:

EDUCATION:

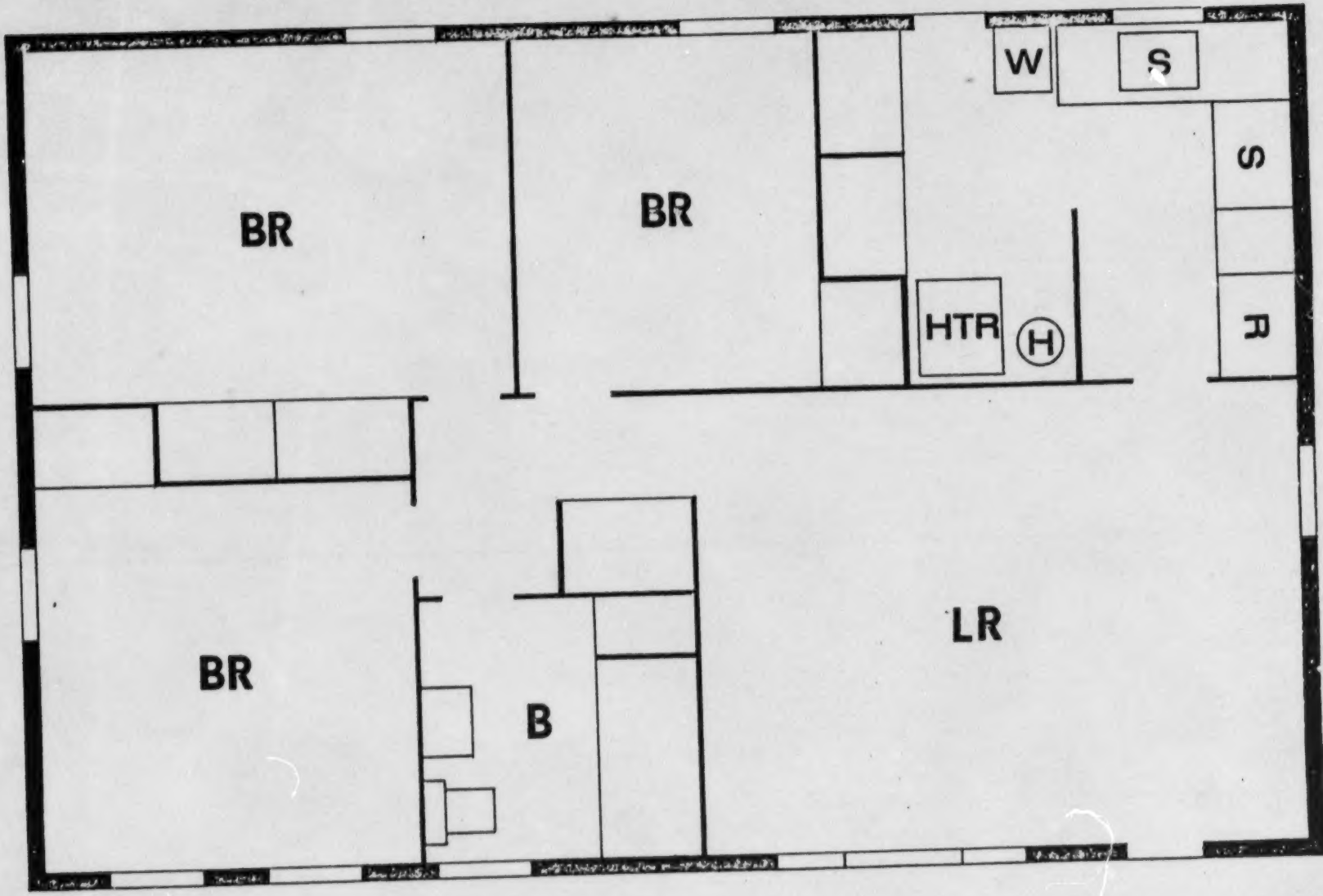
HONORS AND ACTIVITIES:

WORK EXPERIENCE:

COMMUNITY SERVICE:

HOBBIES:

REFERENCE:


W
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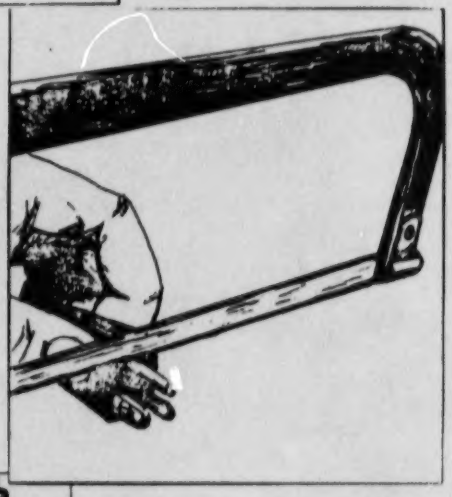
APPENDIX F SAFETY POSTERS

SAFETY POSTER

SAFETY PRECAUTIONS

MODERN HOMES HAVE THREE-WIRE RECEPTACLES.

NEVER CUT OFF THE THIRD PRONG.



USE ADAPTER ON OLD-TYPE RECEPTACLE.

SAFETY PRECAUTIONS

SAFETY POSTER

If a hot wire is in contact with a vehicle and the occupant must get out quickly, he should leap without touching the car again.

To remove a downed wire from a victim, use a non-conductor such as a long dry wooden or plastic pole or a very dry tree branch.

APPENDIX G INSTRUCTIONAL RESOURCES

INSTRUCTIONAL RESOURCES

ELECTRICAL WIRING-HOMEBUILDING

BOOKS AND PRINTED MATTER

1. Electric Safety - Channing L. Bete Co. Inc. - 45 Federal Street, Greenfield, Mass. 01301

2. Safe Grounding of Electrical Equipment - National Safety Council - 425 N. Michigan, Ave., Chicago, Ill. 60611

3. Simplifying Electricity - Bantam Books, Inc. - School and Marketing Division - 666 Fifth Ave., New York, N.Y. 10019

4. Basic Mathematics for Electricity and Electronics - McGraw-Hill Book Co. - 607 Boylston St., Boston, Mass. 02116

5. Electric Power Transmission and Distribution - Clarke Irwin and Company, Limited - P. O. Box 6137, Postal Station G. Vancouver, B.C. Canada

6. What is Electricity? - Frank E. Richards Publishing Co. - 324 First St., Liverpool, N.Y. 13088

7. Handyman' Electrical Repairs Handbook - ARCO Publishing Co. Inc., 219 Park Ave., So. N.Y.

8. Principles of Electrical Theory - McGraw-Hill Book Co. - 607 Boylston St., Boston, Mass. 02116

9. Investigating Electrical Theory - McGraw-Hill Book Co. - 607 Boylston St., Boston, Mass. 02116

10. Electricidad Experimental (Spanish Language) - Regents Publishing Co. - 200 Park Ave., So., New York, N.Y. 10003

11. Experiments with Electricity - Thomas Y. Crowell Co. - 201 Park Ave., So., New York, N.Y. 10003

12. Electricity and Electronics, Basic - American Technical Society - 848 E. 58th. St., Chicago, Ill. 60637

13. Essentials of Electricity and Electronics, Third Edition - McGraw-Hill Book Co. -607 Boylston St., Boston, Mass. 02116

BOOKS AND PRINTED MATTER (cont'd)

14. Basic Electricity (Programmed Instruction) - Westinghouse Learning Corporation - 100 Park Avenue, New York, N.Y. 10017

15. Fundamentals of Electricity, Volume I (Programmed Instruction) - Addison-Wesley Publishing Co., Inc. - Reading, Mass. 01867

16. Fundamentals of Electricity, Volume II (Programmed Instruction) - Addison-Wesley Publishing Co., Inc. - Reading, Mass. 01867

17. How AC and DC Circuits Work Vol. 2 (Programmed Instruction) - The Bobbs-Merrill Company, Inc.- 4300 West 62nd Street, Indianapolis, Ind. 46268

18. Understanding and Using Test Instruments (Programmed Instruction) - The Bobbs-Merrill Company, Inc. - 4300 West 62nd. St., Indianapolis, Ind. 46268

19. Teach Yourself Electricity - Dover Publications, Inc. - 180 Varick Street, New York, N.Y. 10014

20. Questions and Answers for Electricians - Howard W. Sams and Company, Inc. - 4300 West 62nd. St., Indianapolis, Ind. 46268

21. New Electric Library, 10 volumes - The Bobbs-Merrill Company, Inc. - 4300 West 62nd. St., Indianapolis, Ind. 46268

22. New Electric Science Dictionary -Howard W. Sams and Company, Inc. - 4300 West 62nd. St., Indianapolis, Ind. 46268

23. Basic Electricity, Volume 1-5 - Van Valkenburgh, Nooger and Neville, Inc. - 15 Maiden Lane, New York, N.Y. 10038

24. Basic Electricity Theory and Practice - St. Martin's Press - 175 Fifth Ave., New York, N.Y. 10010

25. Electricity - Grosset and Dunlap, Inc. - 51 Madison Ave., New York, N.Y. 10010

ELECTRICAL WIRING-HOMEBUILDING

BOOKS AND PRINTED MATTER (cont'd)

26. Experiments in Electricity, AC (Workbook) - McGraw-Hill Book Co. - 607 Boylston St., Boston, Mass. 02116

27. Guide to the National Electrical Code - The Bobbs-Merrill Company, Inc. - 4300 West 62nd. Street, Indianapolis, Ind. 46268

28. National Electrical Code and Blueprint Reading - American Technical Society - 848 E. 58th. St., Chicago, Ill. 69637

29. Practical Electric Wiring - McGraw-Hill Book Co. - 607 Boylston St., Boston, Mass. 02116

30. Electric Wiring, Theory and Practice - Barnes and Noble - 105 Fifth Avenue, New York, N.Y. 10003

31. Facility and Curriculum Guidelines - State Department of Public Instructions, Olympia, Washington

ELECTRICAL WIRING-HOMEBUILDING

FILMSTRIPS

1. Electricity for Light and Heat - Curriculum Materials Corp. - 1319 Vine Street, Philadelphia, Pa. 19107
2. Static and Current Electricity - Curriculum Materials Corp. - 1319 Vine Street, Philadelphia, Pa. 19107
3. Electric Current Measurement - McGraw-Hill Films - 8171 Redwood Highway, Novato, Calif., 94947
4. Electrical Circuits - Society for Visual Education, Inc. -1345 Diversey Parkway, Chicago, Ill 60614
5. Electric Circuits - Popular Science Publishing Co. - Audio Visual Division - 355 Lexington, Ave., New York, N.Y. 10017
6. Measurement of Resistance - Popular Science Publishing Co. - Audio Visual Division - 355 Lexington, Ave., New York, N.Y. 10017
7. Diagramming Electrical Wiring Circuits - Vocational Agricultural Service - University of Illinois - 434 Mumford Hall, Urbana, Ill. 61801
8. Electrical Terms, Their Meaning and Use - NASCO - Fort Atkinson, Wis. 53538
9. AC and DC Generators - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530
10. AC Voltmeters and Ammeters - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530
11. Electricity (a series of 8) - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530
12. Electricity at Work - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530
13. Resistance - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530
14. Transformers - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530

ELECTRICAL WIRING-HOMEBUILDING

FILMSTRIPS (cont'd)

15. Magnetism, Electricity, and Machines - Bailey-Film Associates - 11559 Santa Monica Blvd., West Los Angeles, Calif. 90025

16. Safe and Sure with Electricity - Popular Science Publishing Co., Inc. - Audio-visual Div., 355 Lexington Ave., New York, N.Y. 10017

ELECTRICAL WIRING-HOMEBUILDING

ADDITIONAL FILMSTRIPS

Basic Electricity and Electronics Explained - Direct Current - Bergwall Productions, Inc., 839 Stewart Ave., Garden City, N.Y. 11530

ELECTRICAL WIRING-HOMEBUILDING

MOVIES

1. 400 Series, Basic Electricity (Super 8mm loop) - Animated Electronic Films - P.O. Box 2036, Eads Station, Arlington, Va. 22202

2. Series and Parallel Circuits (16mm reel) - Encyclopaedia Britannica Educational Corp. - 405 North Michigan Ave., Chicago, Ill. 60611

3. Electric Power Generation (16mm reel) - Serina Press - 70 Kennedy Street, Alexandria, Va. 22305

4. The World Behind Your Light Switch (16mm reel) - Serina Press - 70 Kennedy Street, Alexandria, Va. 22305

5. Connecting Wires in an Outlet Box (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

6. Electrical House Wiring (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

7. Installing a Convenience Outlet (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

8. Outlet Box Installation (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

9. Rewiring a Lamp (Super 8mm loop) - Jam Handy School Service, Inc. -2781 East Grand Blvd., Detroit, Mich. 48211

10. The Third Wire Can Save Your Life (Super 8mm loop) - Jam Handy School Service, Inc. -2781 East Grand Blvd., Detroit, Mich. 48211

11. Toggle Switch Installation (Super 8mm loop) - Jam Handy School Service, Inc. -2781 East Grand Blvd., Detroit, Mich. 48211

12. Trouble-Shooting a Bell Circuit (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

13. Wiring a Box with Armored Cable (Super 8mm loop)- Jam Handy School Service, Inc.-2781 East Grand Blvd. Detroit, Mic. 48211

14. Wiring an Attachment Plug (Super 8mm loop)-Jam Handy School Service, Inc.-2781 East Grand Blvd., Detroit, Mich. 48211

15. Electrical Circuit Faults (16mm reel)-United States National Audiovisual Center-National Archives and Records Service-Washington, D.C. 20409

16. Electricity, Distribution (16mm reel)-Indiana University Audiovisual Center-Field Services Dept., Bloomington, Ill. 47401

17. Safety With Electricity (16mm reel)-Encyclopaedia Britannica Educational Corporation - 405 North Michigan Avenue, Chicago, Ill. 60611

18. Measurement of Electricity (16mm reel)-Coronet Films - 65 E. South Water Street, Chicago, Ill. 60601

19. Basic Electricity (16mm reel)-United States National Audiovisual Center - National Archives and Records Service, Washington, D.C. 20409

20. Basic Electricity, AC Parallel Circuits (16mm reel)-United States National Audiovisual Center, National Archives and Records Service, Washington, D.C. 20409

21. Basic Electricity, AC Series Circuits (16mm reel)-United States National Audiovisual Center, National Archives and Records Service-Washington, D.C. 20409

22. Fires and Wires (16mm reel)-Henk Newenhouse/Novo - 1825 Willow Road, Northfield, Ill. 60093

23. Danger Alive (16mm reel)-Association Films, Inc. - 600 Madison Ave., New York, N.Y. 10022

24. Electricity, Basic Wiring (16mm reel)-Universal Education and Visual Arts - 221 Park Ave. So., New York, N.Y. 10003

A wide variety of 8mm loop films on Electricity are available from the following sources:

Sterling Educational Films
241 East 34th Street
New York, N.Y. 10016

Schoolmasters Science
745 State Circle
Ann Arbor, Michigan 48104

CENCO Educational Aids
2600 S. Kostner Ave.
Chicago, Ill. 60623

Rand McNally and Co.
405 Park Ave.
New York, N.Y. 10022

TRANSPARENCIES

1. Electric Circuit - United Transparencies, Inc. - P.O. Box 688, Binghamton, N.Y. 13902
2. Electric Circuit - DCA Educational Products, Inc.-4865 Stenton Ave., Philadelphia, Pa. 19144
3. Inductance - DCA Educational Products, Inc.-4865 Stenton Ave., Philadelphia, Pa. 19144
4. Production of Alternating and Direct Current - United Transparencies, Inc. - P.O. Box 688, Binghamton, N.Y. 13902
5. Generator - NASCO - Fort Atkinson, Wis. 53538
6. Simple Electric Generator-United Transparencies, Inc.-P.O. Box 688, Binghamton, N.Y. 13902
7. Electric Meter-CCM School Materials, Inc.-2124 West 82nd Place, Chicago, Ill. 60620
8. Power Supply - United Transparencies, Inc.-P.O. Box 688, Binghamton, N.Y. 13902
9. Electrical Charges-DCA Educational Products, Inc.-4865 Stenton Ave., Philadelphia, Pa. 19144
10. Electrical Distribution-CCM School Materials, Inc.-2124 West 82nd Place, Chicago, Ill. 60620
11. Understanding Electricity and Electronics, A Series-McGraw-Hill Films - 8171 Redwood Highway, Novato, California 94947
12. Electric Meters and Resistance-3M Company - Visual Products Division, St. Paul, Minn. 55101
13. Electrical Safety (21 parts) - Popular Science Publishing Co.-Audio Visual Division - 355 Lexington Eve. New York, N. Y. 10017
14. Electrical Circuits, Switches - A. J. Nystrom and Co. - 3333 Elston Avenue, Chicago, Ill. 60618
15. Basic Wiring - 3M Company - Visual Products Division - St. Paul, Minn. 55101
16. Circuits, In Series and Parallel-Creative Visuals - Box 1911, Big Spring, Texas 79720

TRANSPARENCIES (cont'd)

A wide variety of transparencies on Electricity are available from the following sources:

GAF Corporation Reprographic Products
140 West 51st Street
New York, N. Y. 10020

CENCO Educational Aids
2600 S. Kostner Avenue
Chicago, Illinois 60623

McGraw-Hill Films
8171 Redwood Highway
Novato, California 94947

DCA Educational Products, Inc.
4865 Stenton Evenue
Philadelphia, PA 19144

Stansi Scientific Division
1231 North Honore Street
Chicago, Illinois 60622

CCM School Materials, Inc.
2124 West 82nd Place
Chicago, Illinois 60620

Eye Gate House, Inc.
146-01 Archer Avenue
Jamaica, N. Y. 11435

George F. Cram Company, Inc.
School and Library Division
P. O. Box 426
Indianapolis, Indiana 46206

Tweedy Transparencies
208 Hollywood Avenue
East Orange, N. J. 07018

ELECTRICAL WIRING - HOMEBUILDING

LIST OF TOOLS AND SUPPLIES

ELECTRICAL WIRING - HOMEBUILDING

ELECTRICAL WIRING TOOLS

Claw hammers
Electrical drills (With wood and masonry bits)
Hacksaws
Keyhole saws
Needle nose pliers
Lineman's pliers
Vise-grip pliers
Wire cutters/strippers
Diagonal pliers
Screwdrivers
Wood chisels
Cold chisels
Conduit benders
Folding rules, 6 foot
Cable rippers
Utility knives
Fish tape and reel
Test lights
Pipe reamers
Pipe threaders
Pipe cutters
Wire gauges
Soldering irons (electrically heated)
Soldering irons (torch heated)

SUPPLIES AND ACCESSORIES

Solder (50/50)
Soldering flux
Vinyl electrician's tape
Transformer models or cut-aways
AC current source

WIRING DEVICES AND SUPPLIES

Thin-wall conduit
Rigid conduit
Conduit, flexible metal (Greenfield)
Soldering lugs
Solderless connectors
Cable (non-metallic sheathed) connectors
Armored cable bushings and connectors
Conduit connectors
Conduit and cable clamps
Service weather heads
Ground electrodes
Ground clamps
Outlet boxes with covers
Receptacle boxes with covers
Meter sockets
Single-pole switches with plates
Three-way switches with plates
Duplex receptacles with covers
Two-circuit receptacles
Porcelain lamp fixtures with pull chain
Porcelain lamp fixtures (wall switch operated)
Lighting fixtures (wall and ceiling mounted)
115/230 volt receptacles (30 and 50 ampere rated)
Appliance pigtails
Push buttons
Signalling devices (bell or buzzer)
Low voltage transformers

ELECTRICAL WIRING - HOMEBUILDING

OVERCURRENT FIXTURES AND DEVICES

Fuse panels (or circuit breaker panels) 60 ampere
Fuse panels (or circuit breaker panels) 100 ampere
Fuse panels (or circuit breaker panels) 200 ampere
Meter socket and fuse panel combinations, 100 and 200 ampere
Single element fuses, Edison plug type 15, 20, 30 ampere
Time delay fuses, Edison plug type 15, 20, 30 ampere
Time delay fuses, cartridge type 36 to 60, 70, to 100, 110 to 200 amperes
Circuit breakers, single and 2-pole 15, 20, 30, 40, 60, 100 ampere

CONDUCTORS

Single conductor copper wire, insulated (10 gauge or smaller)
Single conductor copper wire, uninsulated (10 gauge or smaller)
Bell wire
Ground wire, uninsulated (No. 4, No. 6)
Armored cable, type ACT 10, 12, 14
Nonmetallic Sheathed Cable, Type NM, Type NMC
10-2, 12-2, 14-2, 10-2 wi/ground, 12-2 w/ground, 14-2 w/ground
Wire, Type TW 12, 14
Cord, Type S 12-3
Cable, Type RHW 6-3

METERS

Kilowatthour meters
Milliammeters
AC Voltmeters
AC Ammeters
Ohmmeters
Megohmmeters
Light meters (foot candle meters)
Amprobe
Digital meters
Galvanometer

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ELECTRICAL WIRING - HOMEBUILDING

NOTE: In addition to the previously listed equipment and supplies, the following instructional aids are recommended as possible additions to any course in electrical wiring derived from this curriculum. No attempt has been made to evaluate the relative merit of the following items; consequently, they should be examined for appropriateness prior to purchase.

MOTOR AND GENERATOR DEMONSTRATION KIT
COPPER VOLTAMETER (Coulometer)
AMPERE'S FRAME APPARATUS
AMPERE'S LAW STAND, MOUNTED CONDUCTOR
DYNAMO ANALYSIS APPARATUS
LAWS OF RESISTANCE BOARD
TEMPERATURE COEFFICIENT OF RESISTANCE APPARATUS
DISSECTABLE TRANSFORMER
PHASE DEMONSTRATOR
Available from CENCO Educational Aids
2600 S. Kostner Ave.
Chicago, Ill. 60623

LINE DROP APPARATUS
Available from STANSI Scientific Division
1231 North Honore Street
Chicago, Ill. 60622

J-e EXPERIMENTER
3-e EXPERIMENTER MARK II
McKNIGHT POWER EXPERIMENTER
Avaiable from McKnight & McKnight
Publishing Co., Bloomington, Ill.
61701

STUDENT LABORATORY PROGRAM, ELECTRICITY AND MAGNETISM
Available from SILVER BURDETTE Co.
Box 362
Morristown, N. J. 07960

ELECTRICAL CIRCUIT MODEL
Available from DENOYER-GEPPERT Co.
5235 Ravenswood Ave.
Chicago, Ill. 60640

CURRENT BALANCE
Available from EDUQUIP INC.
1220 Adams Street
Boston, Mass. 02124

BIBLIOGRAPHY

BIBLIOGRAPHY

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2. Alabama, State Department of Education and USOE, Electrical Wiring - Homebuilding Intermediate. Link Educational Laboratories, Montgomery, Alabama, 1974.

3. Alabama, State Department of Education and USOE, Electrical Wiring - Homebuilding, Final. Link Educational Laboratories, Montgomery, Alabama, 1974.

4. Alabama, State Department of Education and USOE, Electrical Wiring - Homebuilding Instructional Resources. Link Educational Laboratories, Montgomery, Alabama, 1974.

5. Alerich, Walter N. Electrical Construction Wiring. Chicago, Illinois, American Technical Society, 1971.

6. Anderson, Edwin P., Home Appliance Servicing. Howard W. Sams & Co., third ed., Indianapolis, Indiana, 1976.

7. Baker, Gus E. and Crow, Leonard R. Electricity Fundamentals. Indianapolis, Indiana, Howard W. Sams and Co., Inc., 1971.

8. Colvin, Thomas S. Electrical Wiring Residential, Utility Buildings and Service Areas. AAVIM, Athens, Georgia, 1979.

9. Delmar Publishers, Inc., Related Information Electricity I. Albany, New York: Delmar Publishers Inc., 1962.

10. Delmar Publishers Inc., Related Information Electricity II. Albany, New York: Delmar Publishers, Inc., 1962.

11. Hawaii, Department of Education, Industrial Education Curriculum Guide. Honolulu, Hawaii, Department of Education, 1971.

12. Jacobs, Clinton O. and Turner, J. Howard. Developing Shop Safety Skills. AAVIM, Athens, Georgia, 1979.

13. Lemons, Wayne and Price, Bill. Major Appliance Repair Guide. Tab Books, Blue Ridge Summit, Pa. 1971.

14. Lemons, Wayne and Montgomery, Glen. Small Appliance Repair Guide Vol. 1. Tab Books, Blue Ridge Summit, Pa. 1975.

15. Masterton, Robert N. Student Guide for Electrical Construction Wiring. American Technical Society, Chicago, Illinois, 1975.

16. Mileaf, Harry. Electricity One-Seven. Hayden Book Co., Inc., Rochelle Park, New Jersey, 1966.

17. Mix, Floyd M. House Wiring Simplified. South Holland, Ill.: The Goodheart-Willcox Co., Inc., 1977.

18. National Fire Protection Association, National Electrical Code. Boston, Mass: National Fire Protection Association, 1978.

19. Ohio Trade and Industrial Education Service, Residential Wiring Learner's Manual. The Ohio State University, 1963.

20. Ohio Trade and Industrial Education Service, Basic Electricity Instructor's Manual. State Department of Education, Columbus, Ohio, 1964.

21. Oklahoma, State Department of Vocational and Technical Education, Basic Electricity. Stillwater, Oklahoma.

GLOSSARY

GLOSSARY

1.	Alternating current:	(AC) The term meaning that the current reverses at regular intervals.
2.	Ampacity:	Current carrying capacity of electric conductors expressed in amperes.
3.	Approved:	Acceptable to the authority having jurisdiction.
4.	Cable:	Two or more conductors put together inside an overall covering usually moisture or flame retardant.
5.	Circuit:	A complete path through which electricity flows, such as from the power source to a lamp, through the lamp, and back to the power source.
6.	Circuit breaker:	A safety device which opens the circuit by tripping a switch rather than burning.
7.	Conductor:	The wires which carry the electricity or through which electricity flows.
8.	Conduit:	A metal or fiber pipe or tube used to enclose electrical conductors.
9.	Cord:	Several small wires wrapped in insulation, then covered with another layer of insulation. Usually referred to as extension cords or lamp cords.
10.	Device:	A unit of an electrical system which is intended to carry but not utilize electric energy. i.e. switches, plugs, fuses.
11.	Direct current:	(DC) The term meaning that the current flows in one direction at a continuous rate.
12.	Electricity:	A source of energy that can be easily coverted into light, heat, or power.

13.	Equipment:	A general term including materials, fittings, devices, appliances, fixtures, apparatus, and the like used as a part of, or in connection with, an electrical installation.
14.	Fish tape:	A flat spring steel wire used to pull "fish" wires through conduits or walls
15.	Fitting:	Accessory such as a bushing, or locknut used on wiring system intended primarily to perform mechanical rather than electrical function.
16.	Fuse:	A safety device which burns out when the current becomes too great.
17.	Hot wires:	A current carrying conductor with electrical pressure on them.
18.	Insulation:	A protective covering over wires to prevent completing a circuit except where desired.
19.	Junction box:	An outlet box with a blank cover used to contain splices of a circuit.
20.	Knockout:	Circular metal die-cut impression in outlet and switch boxes, not completely severed, which may be removed to accommodate wiring.
21.	Outlet:	A point on the wiring system at which current is taken to supply utilization equipment. i.e. lighting outlet, receptacle outlets
22.	Overload:	Current demand which is greater than that for which the circuit or equipment was designed.
23.	Qualified person:	Person who is thoroughly familiar with construction and operation of apparatus and hazards involved.
24.	Romex:	Nonmetallic sheathed cable used for indoor wiring.
25.	Schematic diagram:	Step used in electrical wiring showing the connections that needs to be made and usually used to trace flow of current when troubleshooting.

26.	Screw terminal:	Means for connecting wiring to devices, which makes use of a threaded screw.
27.	Short circuit:	An improper connection between hot and neutral wires or between hot wires.
28.	Single phase:	A type of electric service usually available to most residential dwellings requiring one transformer between power supplier and customers.
29.	Skinning (wire):	Removing insulation
30.	Splice:	Connection made by connecting two or more wires.
31.	Switch:	A device used to open or close a circuit
32.	Voltage drop:	A loss in electrical pressure from its source to its point of use.
33.	Wire:	A single conductor which carries electricity.
34.	Wire gauge:	A tool used to measure wire diameter
35.	Wire size:	The measure of a wire diameter.